NUCLEAR SCIENCE ABSTRACTS

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Second UNITED NATIONS INTERNATIONAL CONFERENCE ON THE PEACEFUL USES OF ATOMIC ENERGY

Geneva, 1958

Non-United States Papers

April 30, 1959

Volume 13 Number 8 SUPPLEMENT

Abstracts 5993–7331

UNITED STATES ATOMIC ENERGY COMMISSION

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NUCLEAR SCIENCE ABSTRACTS

Volume 13 Number 8 April 30, 1959

SUPPLEMENT

This special issue covers the non-United States papers prepared for presentation at the Second United Nations International Conference on the Peaceful Uses of Atomic Energy. The United States papers were abstracted in Nuclear Science Abstracts, Volume 12, No. 20 Supplement, (October 31, 1958).

GENERAL

5993 A/CONF/15/P/94
THE APPLICATION OF RADIOTRACERS TO THE MEASUREMENT OF ENGINE WEAR IN MOVING VEHICLES. J. H. Deterding and J. R. B. Calow (Shell Research Ltd., Chester, Eng.). 11p.

The use of radioactive parts in engines makes possible the determination of wear occurring under various running conditions and with different lubricants and fuels. The technique avoids the need for tests of long duration or for dismantling the engine between tests. One method involves the measurement of the concentration of radioactive wear debris which accumulates in the engine oil, and this can produce a continuous record of wear. The application of the method to the study of piston ring wear in a car engine under actual running conditions is described, the measurements being made recorded in the moving vehicle. Details are given of the equipment used and of some typical results obtained. (auth)

5994 A/CONF.15/P/126
LA MESURE CONTINUE DE LA RADIOACTIVITE DES AEROSOLS ATMOSPHERIQUES. (Continuous Measurement of the Radioactivity of Atmospheric Aerosols.) Robert Quivy (Inst. Interuniversitaire des Sciences Nucléaires, Brussels and Faculté Polytechnique de Mons, Belgium). 19p.

In order to measure continuously and without delay the radioactive pollution of the atmosphere, the alpha and beta activities of dust collected on filters are detected simultaneously. By the simultaneous detection of the alpha and beta particles emitted by the deposit on the filter, the relative value of the atmospheric pollution is easily determined. To calculate the absolute value of the pollution, the geometric yield of the counter, the distribution law for the dust in the filter layers, and the absorption of beta particles in the filter are determined. (tr-auth)

5995 A/CONF.15/P/132
FUTURE PROSPECTS OF NUCLEAR POWER IN THE ELECTRIC POWER ECONOMY OF TAIWAN. Hui Huang (Taiwan Power Co., Taipei, China). 17p.

The power system of Taiwan is principally hydroelectric with steam power complement. The natural resources of Taiwan for electric power generating purposes consist of water, coal, and Th-containing monazite. Nuclear power will be economically justified within the next ten-year period for purpose of supplementing hydro power. (W.L.H.)

5996 A/CONF.15/P/134
NUCLEAR AND CONVENTIONAL THERMAL POWER IN A TYPICAL HYDRO-ELECTRIC SYSTEM. SOME ASPECTS OF THE MOST ECONOMICAL RELATION BETWEEN NUCLEAR AND CONVENTIONAL POWER. C.-E. Lind, G. Lindström, and J.-E. Ryman (AKK Atomic Power Group, Stockholm). 30p.

It is a characteristic of a water power system that the run-off does not coincide with the demand. Although storage reservoirs will lessen this inconvenience to some extent, it is concluded from economic considerations that water power, with high capital costs and low operating costs, should be supplemented with some sort of thermal power where the cost characteristics are reversed. Starting from the point of view of the cost characteristics of thermal power, the need of the system for a supply of nuclear power as a function of the corresponding costs is discussed. Since the operating costs of a hydroelectric plant are negligible, the nuclear power plants should be operated only when the presumed value of the water in storage is higher than the operating costs of the nuclear power plants. (W.D.M.)

5997 A/CONF.15/P/166
RECENT USES OF RADIOISOTOPES IN TECHNOLOGICAL RESEARCH AND CONTROL IN SWEDEN. Lars-G. Erwall and Knut Ljunggren (Kungl. Tekniska Högskolan, Stockholm). 27p.

A survey of recent industrial applications of tracer techniques in Sweden is presented. An account is given of some investigations made in the cellulose, peat, cement, sugar refining, and iron and steel industries. An analysis of the investigations reported shows that the solution of many technological problems depends more on physical labeling of a certain phase of material than

on exact chemical identity. This affords a wider range of possibilities for the selection of the nuclide most attractive from the point of view of safety. (W.D.M.)

5998 A/CONF.15/P/206
LONG-RUN TRENDS IN CONVENTIONAL AND NUCLEAR POWER COSTS AND THEIR IMPLICATIONS FOR CANADA. J. Davis (British Columbia Electric Co. Ltd., Vancouver) and S. W. Clarkson (Atomic Energy of Canada Ltd., Chalk River, Ont.). 29p. (AECL-616). $0.25(AECL)

Most studies which have attempted to forecast the role of nuclear power have been deficient in one important respect: a static rather than a dynamic approach has been used. In this study distance, in the sense of power losses and transmission line costs, is taken into account. The time element has also been considered. Technological improvements in hydro, conventional, and nuclear plants are given their proper weighting. Capital costs and interest rates are considered. (W.D.M.)

5999 A/CONF.15/P/207
THE ECONOMIC ENVIRONMENT FOR NUCLEAR POWER IN CANADA. J. L. Olsen, E. C. Savage, et al. (Canadian General Electric Co. Ltd., Peterborough, Ont.). 18p. (AECL-617). $0.25(AECL).

The energy reserves (coal, oil, gas, and hydro) of Canada are discussed in regard to their location and cost of transportation. The energy requirements of the major regions of Canada for the next ten years are reviewed. Assuming a price drop in natural uranium oxide fuel, a 25% plant efficiency, and identical operating and maintenance charges, capital costs which would meet the competitive threshold in each of the areas are given. (W.D.M.)

6000 A/CONF.15/P/262
THE U. K. PROGRAMME FOR THE DEVELOPMENT OF NUCLEAR POWER. W. Strath (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). 12p.

The energy resources in the U.K. are reviewed, and the possible power demands for the next twenty years are discussed. The development of the nuclear power program is outlined and its flexibility emphasized. The short-term responsibilities of industry and the UKAEA are described. The interrelationship between the various reactor systems under consideration and the reasons for the selection of a limited number for development are examined. (W.D.M.)

6001 A/CONF.15/P/269
EDUCATION AND TRAINING IN REACTOR TECHNOLOGY AND RADIOISOTOPE TECHNIQUES IN THE UNITED KINGDOM. I. Cartwright and K. Frost (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.), J. Diamond (Univ. of Manchester, Eng.), R. A. Faires, J. E. M. Johnston, D. J. Littler (Atomic Energy Research Establishment, Harwell, Berks, Eng.), J. M. Kay and W. Murgatroyd (Univ. of London), J. Walker (Birmingham Univ., Eng.), and D. F. Welch (John Thompson Nuclear Energy Co., Ltd., Knutsford, Eng.). 12p.

The demand for education and training in reactor technology in the U.K. can be divided into research work, reactor design and construction, and reactor operation. The various courses which have been inaugurated by the UKAEA and the universities are described. The ways in which industrial firms train their staffs are discussed. The facilities for education and training which are offered to overseas students are described, and an account is given of the training of foreign students who have already attended some of the courses. The work of the isotope school at A.E.R.E. Harwell and other radioisotope courses in the U.K. are described. (W.D.M.)

6002 A/CONF.15/P/341
UN INVESTISSEMENT DIFFICILE: LE RECRUTEMENT DE PERSONNEL SCIENTIFIQUE ET TECHNIQUE POUR LE COMMISSARIAT A L'ENERGIE ATOMIQUE. (A Difficult Investment: The Appointment of Scientific and Technical Staffs for the Commissariat a l'Energie Atomique, French Atomic Energy Commission) (C.E.A.). G. Bardet (Commissariat à l'Énergie Atomique, Paris). 12p.

The expansion of the use of nuclear energy in France has increased the need for scientific and technical staffs. An estimate of the need for scientific personnel by the Commissariat a l'Energie Atomique indicates an annual recruitment of 300 engineers and 400 technical personnel. The steps taken by the Commission to ensure this supply are discussed. The training opportunities offered in its Nuclear Research Centers are described. (J.S.R.)

6003 A/CONF.15/P/571
THE NETHERLANDS'-NORWEGIAN REACTOR SCHOOL. J. A. Goedkoop and N. Holt (Joint Establishment for Nuclear Energy Research, Kjeller, Norway). 2p.

A brief account is given of the Reactor School at Kjeller, Norway, and the developments which led to its foundation. (J.S.R.)

6004 A/CONF.15/P/982
CONTINUOUS CONTROL AND MEASUREMENT OF LEVELS AND DENSITIES BY GAMMA RAYS. Adolf Trost (Wildbad/Schwarzwald, Ger.). 8p.

Level control, measurement, and regulation by radioisotopes has been largely adopted in all those cases where orthodox methods, such as floats and probing gages, fail when levels of corrosive or highly viscous liquids have to be measured or if measurements have to be carried out at high pressures or temperatures as well as in cases of solid and molten materials. In the Federal Republic of Germany about 400 instruments of this kind are in operation. In most cases the absorption of gamma rays by the filling material is used to obtain an indication of the level. The usual sources applied are Co^{60} or Cs^{137}. (auth)

6005 A/CONF.15/P/987
INVESTIGATIONS ON THE FIELD OF PNEUMATIC AND HYDRAULIC CONVEYING OF FINE COAL BY TRACER METHODS. Kurt Sauerwein and Rüdiger Hossner (Isotopen-Lab. Dr. Sauerwein, Düsseldorf). 10p.

In coal mining hydraulic and pneumatic conveying methods are used increasingly, although considerable difficulties have to be overcome. By labeling of coal grains with Br^{82}, it was possible to answer several questions about these difficulties. (W.D.M.)

6006 A/CONF.15/P/988
THE RADIOACTIVE INDICATOR METHOD WITH Sb 124 TO INVESTIGATE THE MIGRATION OF LEAD STORAGE BATTERY GRID ANTIMONY. W. Herrmann, W. Ilge, and G. H. Proepstl (Isotopen-Studiengesellschaft e. V. Inst., Düsseldorf). 14p.

By means of tracer techniques the conditions existing in lead storage cells due to the presence of antimony were investigated. Sb^{124} was incorporated into the melt for the plates. Autoradiographs, tables, and graphs are

shown and details given of the measurements and electrochemical reactions. (W.D.M.)

6007 A/CONF.15/P/1093
THE DESIGN AND CONSTRUCTION OF RESEARCH FACILITIES FOR A POWER DEVELOPMENT PROGRAMME. G. L. Miles and C. N. Watson-Munro (Australia). 19p.

Some of the problems met in establishing, in a country of limited financial and technological resources, atomic energy research facilities capable of supporting a power development program are outlined. In addition to discussing the general policy underlying the selection of the site, and the type of research program to be undertaken, technical and cost details of the irradiation and active handling facilities found necessary for a limited power research project are given. (auth)

6008 A/CONF.15/P/1140
FORMATION DES SCIENTIFIQUES ET TECHNICIENS AU CENTRE D'ETUDES NUCLEAIRES DE SACLAY. (The Formation of Scientists and Technicians at the "Centre d'Etudes Nucleaires" at Saclay). Jean Debiesse (Commissariat à l'Énergie Atomique, Paris). 6p.

The development of a nuclear industry in France will mean an increased need for scientists, engineers, and technicians. To ensure a supply of well-trained workers, the National Institute of Nuclear Sciences and Nuclear Technics was formed with close cooperation between the universities and the Centre d'Etudes Nucleaires at Saclay. The program offered is described briefly. An accelerated teaching program was initiated to graduate engineers in four years. An effort was made to absorb technical assistants into professional centers more quickly. A propaganda program was initiated to inform the general public on the need for scientific education and to interest high school students in scientific vocations. (J.S.R.)

6009 A/CONF.15/P/1141
L'ENSEIGNEMENT DE GENIE ATOMIQUE DE L'INSTITUT NATIONAL DES SCIENCES ET TECHNIQUES NUCLEAIRES AU CENTRE D'ETUDES NUCLEAIRES DE SACLAY. (The Atomic Energy Course of the Institut National Des Sciences et Techniques Nucleaires at the Centre D'Etudes Nucleaires at Saclay.) Henri Baissas (Commissariat à l'Énergie Atomique, Paris). 52p.

A description is given of the creation and operation of the atomic energy course offered at Saclay for scientists already working in industry. A list of the theoretical courses and the practical work and samples of the examinations are given. (J.S.R.)

6010 A/CONF.15/P/1142
PREPARATION SCOLAIRE DU PERSONNEL SCIENTIFIQUE ET TECHNIQUE. (Academic Training of Scientific and Technical Personnel.) A Chatelet (Univ. of Lille). 26p.

The academic training of scientific and technical personnel in France is surveyed. The establishments where future atomic energy personnel are receiving their education are the following: the universities and Faculties of Science, the great science schools and institutions offering specialized courses in scientific techniques, research centers, schools offering a special educational cycle to train graduate personnel for research work, and technical schools offering courses for technicians and craftsmen. Each category is briefly discussed. (J.S.R.)

6011 A/CONF.15/P/1152
LES BETONS LOURDS. PROPRIETES PHYSIQUES ET ESSAIS MECANIQUES. (Heavy Concretes).
M. Tourasse (Compagnie Industrielle de Travaux, France). 25p.

The utilization of high-density substances for shielding against nuclear radiation has led to the use of heavy concretes in which the aggregates are iron or barite ores or iron shot. The physical and mechanical properties of these concretes were determined. The results obtained with some other concretes are briefly discussed. (J.S.R.)

6012 A/CONF.15/P/1231
SOME NEW APPLICATIONS OF RADIO ELEMENTS IN FRANCE. P. Leveque, R. Hours, et al. (Commissariat à l'Energie Atomique, Paris). 23p.

Some applications of radioisotopes which have not been previously published are described. By measuring the transmission of a flat beam of thermal neutrons, the moisture content of a parallelepipedon-shaped soil sample can be measured to ±4% and the moisture gradient along the longitudinal axis determined. The method permits the determination of chemically bound water and the measurement of diffusion coefficients of water into low hydrogenated materials. By measuring the intensity of fluorescence excited by β radiation, it is possible to determine the thickness of metal coatings of less than 20 μ for metals of atomic number less than 40. This method was applied to chromium, manganese, iron, cobalt, nickel, copper, and zinc. By using a suitable metal filter, it is possible to measure coating thicknesses of metals differing by only one atomic number from the supporting material. By employing labeled cement, it is possible to determine the extent of movement of cement grout used for soil stabilization and impermeabilization. The kinetics of ion exchange of lapis lazuli in aqueous solutions was studied by tracing the movement of labeled ions in the solution or in the exchanger. Values of the diffusion coefficients and activation energies were determined from the exchange studies. (auth)

6013 A/CONF.15/P/1304
PROSPECTS FOR THE USE OF NUCLEAR ENERGY IN THE ROMANIAN POPULAR REPUBLIC. M. Bercovici, I. Saphier, and A. Szmuk. 7p.

The energy resources and demands of Rumania are discussed, and a review is presented, from the technical and economic standpoints, of the advisability of bringing nuclear power into the over-all energy program for the period extending from 1960 to 1975. (W.D.M.)

6014 A/CONF.15/P/1318
THE LONG-TERM PLAN FOR DEVELOPMENT OF ATOMIC POWER REACTOR OF JAPAN. AN EXAMPLE FOR THE DEVELOPMENT OF ATOMIC POWER GENERATION. (Atomic Energy Commission of Japan). 41p.

The Japanese program includes the construction of a 10- to 15-Mwe enriched uranium water-cooled reactor, 1- to 10-Mwe thermal and fast breeder reactors, and a 100-Mwe power breeder reactor about 1970. The objective of the program is that about one half of the power plants installed after 1966 shall be nuclear plants. The funds for carrying out this program and its effects on the balance of foreign exchange are discussed. (W.D.M.)

6015 A/CONF.15/P/1319
NUCLEAR POWERED EMIGRANT SHIP. Seiichi Takeuchi (Osaka Shosen Kaisha (O.S.K. Line), Japan); Takashi Okamura (Mitsubishi Heavy-Industries,

Reorganized, Ltd., Japan); and Sotoo Murakami (Ishikawajima Heavy-Industries Co., Ltd., Japan). 49p.

A nuclear-powered emigrant ship has been designed and would operate between Japan and the East Coast of South America, a distance of 12,000 miles. The ship would be 20,000 tons gross with a cruising speed of 23 knots. The main propulsion machinery would consist of two sets of 22,000 SHP steam turbines using saturated steam. A pressurized light water reactor was chosen because of its light weight, small size, and reliability, and also because of its proven performance for marine propulsion. (W.L.H.)

6016 A/CONF.15/P/1320
NUCLEAR-POWERED SUBMARINE TANKER. Michiya Shigemitsu (Kobe Shipyard & Engine Works, Japan). 38p.

A brief outline of a detailed study and research project of a trial design for a nuclear-powered submarine oil tanker is presented. (W.L.H.)

6017 A/CONF.15/P/1347
PRESENT STATUS OF USE OF RADIO-ISOTOPES IN NON-DESTRUCTIVE INSPECTION. Tadashi Oshida (Kobe Kogyo Corp.), Masao Kato (Tokyo Univ.), Tamaki Watanabe (Industrial Research Inst. of Japanese Government, Nagoya, Japan), and Takashi Fuji (Japan Steel and Tube Corp.). 22p.

Industrial applications of non-destructive testing with radioisotopes are mainly defect testing by the photographic method. However, the field is expanding and new methods are described. Co^{60} with two scintillation counters for inner defects in processed metal items, Tm^{170} radiography for testing light alloys, bremsstrahlung as a radiation source in thickness gauging, and gamma absorption in steel are the procedures described. (W.D.M.)

6018 A/CONF.15/P/1363
NUCLEAR POWER PROGRAM IN ITALY. Basilio Focaccia (Comitato Nazionale per le Richerche Nucleari, Milan). 7p.

The shortage of conventional power sources in Italy has led to increased interest in the development of nuclear power plants. The program initiated by the government with the cooperation of private industry to develop nuclear power in Italy is briefly described. (J.S.R.)

6019 A/CONF.15/P/1407
THE FUTURE OF NUCLEAR POWER IN PAKISTAN. A. A. M. Abmad (Atomic Energy Commission, Karachi, Pakistan). 14p.

An account of nuclear power as a future source of energy in the economic and industrial development of Pakistan is given. (auth)

6020 A/CONF.15/P/1445
ECONOMICS OF COMBINED NUCLEAR AND PUMPED STORAGE SCHEMES FOR THE POWER SUPPLY INDUSTRY. W. Szwander (Belfast Corp., N. Ire.). 16p.

The main cost features of nuclear generation are pointed out to be relatively high installation cost and low operating costs. In medium and small systems where a nuclear power station will generate a significant fraction of the total power, provision must be made to utilize them at a high load factor in order to benefit from the low operating costs. The introduction of a pumped storage scheme offers many benefits in this respect. (W.D.M.)

6021 A/CONF.15/P/1446
ECONOMIC ASPECTS OF THE UNITED KINGDOM NUCLEAR POWER PROGRAMME. J. C. Duckworth (Central Electricity Generating Board, London) and E. Hywel Jones (South of Scotland Electricity Board, Glasgow). 16p.

The projected United Kingdom nuclear power program over the next eight to nine years is briefly reviewed. Generation costs for the nuclear stations under construction are given and compared with those for typical modern conventional stations which will be completed at about the same time. Nuclear generation costs for stations in the remainder of the program are estimated. Factors influencing costs are described, including life of the plant and methods of minimizing fuel costs by control of fuel replacement. The development of the U.K. electricity generating system, in the light of the costs given, is described. Future developments are considered, particularly the influence of pumped storage, conventional fuel fired super-heating, the trend of nuclear fuel costs, and the variation in available load factors. (auth)

6022 A/CONF.15/P/1447
ECONOMIC OPERATION OF NUCLEAR REACTORS ON AN ELECTRIC SUPPLY SYSTEM. Geoffrey F. Kennedy and S. J. Cowherd (London). 22p.

A number of typical electric supply systems are considered, and the operation of different types and sizes of reactors on them is assessed. This assessment is initially made on the assumption that there is no possibility of energy storage. Energy storage is introduced as an extra variable. Type of storage, cost of plant, and availability and position of sites are the major considerations. A reassessment of the position for the various reactor systems considered is made with different energy storage capacities and costs. (auth)

6023 A/CONF.15/P/1527
I. THE PRODUCTION OF ELECTRICAL ENERGY FROM NUCLEAR SOURCES IN URUGUAY IN THE COURSE OF THE NEXT 25 YEARS. II. HYDROELECTRIC POWER RESERVES. III. PROSPECTS FOR THE USE, IN URUGUAY OF ELECTRICITY PRODUCED BY NUCLEAR REACTORS. (Uruguayan National Atomic Energy Commission, Montevideo). 53p.

The electric power program in Uruguay is reviewed, and the present and projected demands are discussed. The hydroelectric power resources which can be utilized are described and the deficit discussed in terms of either conventional or nuclear generation. (W.D.M.)

6024 A/CONF.15/P/1536
METEOROLOGICAL ASPECTS OF THE PEACEFUL USES OF ATOMIC ENERGY. (World Meteorological Organization, Geneva). 37p.

The meteorological aspects of the safety and location of nuclear reactors are dealt with in some detail. The various uses of radioactivity in meteorology are discussed with particular reference to the value of C^{14} in various phases of meteorological work. (W.D.M.)

6025 A/CONF.15/P/1593
THE PERSPECTIVES OF THE POLISH NUCLEAR ENERGY PROGRAMME. S. Andrzejewski, J. Latour, P. J. Nowacki, M. Taube (Academy of Sciences, Warsaw), and R. Pomerski (Office of the Government Plenipotentiary for the Utilization of Nuclear Energy, Warsaw). 16p.

Estimates on the population growth and possible industrial development are presented. A study of Polish

power resources and their future utilization as regards the covering of all energy demands is given in detail. The survey was made for a span of time up to 1975. It is deemed advisable to start the nuclear power program by 1965. (W.D.M.)

6026 A/CONF.15/P/1616
A RADIOISOTOPE TRAINING CENTER AT REHOVOTH, ISRAEL. M. Anbar (Weizmann Inst. of Science, Rehovoth, Israel). 19p.

A training school in the various applications of radioisotopes was established at the Weizmann Institute of Science, Rehovoth, Israel. In order to get the best results, the number of participants in each training course was limited to 12 to 18 persons, all of a similar scientific or technical background and with similar prospects of work in radioisotope application. Thus, special courses were held during 1957 for analytical and physical chemists, agriculturists, soil scientists and biologists, and for electrical and mechanical engineers; each course had a different curriculum adapted to the specific requirements of the participating group. The courses planned for 1958 are meant for radiochemists, physicians, and hydrologists and sanitary engineers. Each course lasts 2 to 3 months and includes about 120 lecture hours and 150 hours of laboratory work. The curriculum of each course includes lectures on nuclear physics, instrumentation, health physics, and applications of radioisotopes. Courses for chemists include additional lectures on radiochemistry, radiation chemistry, hot atom chemistry, waste disposal, and radiochemical technology. The courses for engineers include additional material on reactor physics and construction, electronics, and automatic controls. The courses for physicians and biologists include additional material on tracer methodology and on medical and biological applications. The laboratory exercises include basic experiments in nuclear physics, instrumentation including electronics, radiochemical separation procedures, shielding and dosimetry, and various applications of radioisotopes. In addition to the major courses, short summer courses are held for high school teachers and health physics technicians. Details are presented of the curricula of each course as well as of experiments and exercises which have been specially designed for these courses. (C.H.)

6027 A/CONF.15/P/1624
A STUDY OF THE CONTRIBUTION OF ATOMIC ENERGY TO A POWER PROGRAMME IN INDIA. H. J. Bhabha (Atomic Energy Commission, India) and N. B. Prasad (Atomic Energy Establishment, Trombay, India). 27p.

A detailed comparison is made of the relative economics of a conventional thermal power station with an atomic power station of a capacity between 150 and 300 Mw, at a typical location. In view of the need to base the ultimate power production on thorium rather than uranium, possible power programs are discussed in which thorium progressively replaces uranium as feed material, and the effect of different rates of plutonium and U^{233} production on the rate of growth of installed capacity is calculated. The relative costs to the economy as a whole of a given increase in electric power production based on conventional thermal or nuclear power programs are estimated, including the capital investment required for the mining of the fuel and its treatment, its transport, and the capital investment in power stations. (auth)

6028 A/CONF.15/P/1642
STUDY OF FUEL CYCLES WITH REFERENCE TO A POWER PROGRAMME. M. Dayal, S. R. Paranjpe, N. B. Prasad, and B. Singh (Atomic Energy Establishment, Trombay, India). 14p.

As the thorium reserves of India are much larger than the uranium reserves, any large-scale nuclear power program has to be based ultimately on the thorium–U^{233} cycle. However, special fissile material will be required to start this cycle, and therefore a beginning has to be made with natural uranium reactors. These reactors will convert some U^{238} to plutonium, which may be used in the second generation of power reactors. These may either be fast reactors where U^{233} can be produced from thorium in the outer blanket with some net breeding gain or thermal reactors producing slightly less U^{233} than the plutonium consumed. This will then be the starting point for the third generation of power reactors using U^{233} as fissile material and thorium as fertile material. Estimates of the total capacity required in the first generation and second generation of reactors to make the transition in a given time are presented. (auth)

6029 A/CONF.15/P/1727
ANALYTICAL AND ECONOMIC INVESTIGATION OF PLUTONIUM PRODUCTION IN NUCLEAR POWER REACTORS. Andras Levai, Imre Kováts, and Gergely Büki (Budapest Technical Univ.). 45p.

A brief survey of the cost analysis of nuclear power plants is given. The evaluation of plutonium production is based on physical and economic factors of a very heterogeneous character. When attaining different burnup levels, the value of the extracted plutonium can be determined with reference to the time of production. The burnup level at which it is economical to extract the plutonium is established. (W.D.M.)

6030 A/CONF.15/P/1822
THE PROBLEM OF ELECTRIC ENERGY IN PORTUGAL. ROLE OF NUCLEAR POWER. Alberto Abecasis Manzanares (Junta de Energia Nuclear, Lisbon) and Fernando Ivo Gonçalves (Companhia Nacional de Electricidade, Lisbon). 9p.

Bearing in mind the particular position of Portugal with regards to the possibility of production, characteristics, and cost of hydro-electric power, the eventual use of nuclear production is envisaged. The best time to put it to use is studied taking into account future technical developments in the operation of nuclear plants. Some aspects are discussed concerning the installed capacity to be considered in future hydro-electric plants, reckoning with the possible use of nuclear power and with the versatility of its operation. Advantages are mentioned for using hydro-electric pumped storage together with nuclear power plants, which being connected to the grid could, perhaps, reduce the very high load factor of nuclear power plants. (auth)

6031 A/CONF.15/P/1957
THE RADIOACTIVITY OF RAIN WATER IN LISBON FROM OCTOBER 1957 TO APRIL 1958. Branca Edmée Marques and Maria Regina Sales Grade (Comissão de Estudos da Energia Nuclear, Lisbon). 21p.

Some of the results obtained in a study on radioactivity in rainwater are summarized. Rain that fell in Lisbon from October 1957 to April 1958 was col-

lected in a large plastic basin. The suspended matter was removed by means of a funnel under pressure. (W.D.M.)

6032 A/CONF.15/P/1959
MONITORING OF FALLOUT RADIOACTIVITY OF RAIN AND SNOW WATERS BY MEANS OF LIQUID COUNTERS. F. G. Houtermans and C. Mühlemann (Univ. of Bern). 5p. Addendum 1. 6p.

For the measurement of the activities of cistern waters the errors introduced by the varying amount of solid residue due to salts in the rain water are possibly in excess of 50%. In order to avoid this uncertainty, counters were used in which the tube of thin-walled glass is surrounded by a mantle of liquid, obtained by evaporation of rain water to a known amount. Efficiencies of these counters were measured for several beta emitters. Activity in cistern water around Bern was measured. (W.D.M.)

6033 A/CONF.15/P/1963
NEW MEASUREMENTS ON THE WORLD-WIDE DISTRIBUTION OF NATURAL AND ARTIFICALLY PRODUCED TRITIUM. F. Begemann (Univ. of Chicago and Max-Planck-Inst. für Chemie, Mainz). 14p.

About seventy samples of rain and snow collected in various places on the northern hemisphere during the period from January 1956 to July 1957 have been analyzed for their tritium content. Data are presented for Chicago, Bern, and various locations in the Arctic. Following the U. S. test series of thermonuclear devices in the Pacific during the summer of 1956, the variation in the tritium content of the samples from the various locations shows essentially the same pattern as it did following the test series during 1954, i.e., a sudden increase followed by a gradual decrease to a new and higher "equilibrium level." (auth)

6034 A/CONF.15/P/2089
DEVELOPMENT OF INTERNATIONAL COLLABORATION IN THE PEACEFUL USES OF ATOMIC ENERGY. Paul R. Jolles (International Atomic Energy Agency, Vienna). 20p.

Various types and methods of international collaboration in the field of the peaceful uses of atomic energy are described which have developed in recent years, the inter-relationship between international endeavors in this field, and the role of the International Atomic Energy Agency as a world-wide organization for coöperation and coördination. (auth)

6035 A/CONF.15/P/2092
TEKHNOLOGICHESKIE I EKONOMICHESKIE ASPEKTY STROITEL'STVA ATOMNOI ELEKTROSTANTSII V CHSR. (The Technical and Economical Aspects of Nuclear Power Plant Construction in Czechoslovakia). A. Shevchik (Czechoslovakia). 18p.

The high cost for the production of electrical energy by classical methods in Czechoslovakia contributes to the importance of developing nuclear power sources in that country. The first nuclear power plant planned is a thermal neutron reactor using natural uranium as fuel, heavy water as moderator, and carbon dioxide as coolant. Two power plant layouts are given and discussed. Some special technical features of the prototypes are described. Consideration is given to the economic characteristics of the reactor, and the prospects for future development are discussed. (J.S.R.)

6036 A/CONF.15/P/2093
PODGOTOZKA KADROV YADERNYKH SPETSIALISTOV V CHEKHOSLOVAKII. (Training of Specialists in the Field of Nuclear Science in Czechoslovakia). B. Kvasil (Czechoslovakia). 11p.

University training in nuclear physics, nuclear engineering, and radiochemistry is chiefly concentrated at the Faculty of Applied and Nuclear Physics in Prague. Some institutions of higher learning have supplementary lectures in nuclear sciences, and post-graduate courses are organized for engineers working in research institutes and in industry. Training is also given at the technical school level. An outline of the organization of the individual levels, of the curricula, and the perspectives is given. A number of students and post-graduates obtain training at Soviet universities and research institutes. Some Czechoslovakian scientists have also received training in western European countries. (J.S.R.)

6037 A/CONF.15/P/2198
INVESTIGATION OF MECHANISM FOR PROTECTING FRICTION SURFACES FROM CORROSION WEAR. Y. S. Zaslavskii (Zaslavsky), G. I. Shor, and R. N. Shneyerova (U.S.S.R.). 26p.

Radiochemical methods which allow observing both the formation of the protecting film on the metal surface and kinetics of the corrosion of metals were employed to study the action mechanism of additives reducing the corrosion of bearing brasses. The investigation of various phosphorus- and sulfur-containing organic compounds labelled with P^{32}, S^{35}, and C^{14} has made it possible to observe and study the protecting films retarding the corrosion of metal caused by lubricant oxidation products. (auth)

6038 A/CONF.15/P/2234
KOBAL'TOVYE ISTOCHNIKI VYSKOI INTENSIVNOSTI DLYA RADIATSIONNYKH VOZDEISTVII. (Cobalt-60 High Intensity Sources for Radiation Research.) A. V. Bibergal, V. L. Karpov, and V. I. Sinitsyn (U.S.S.R.). 19p.

A brief survey of some experimental results on the use of radiation in biology, radiation chemistry, and medicine is presented. The requirements of irradiation techniques in various fields of application are formulated. The latest developments and present state of irradiation techniques using cobalt-60 sources are described. Data on the high intensity cobalt-60 sources being used or designed for irradiation effects studies in the fields of biology, radiation chemistry, and medicine are given. In conclusion the future trends in development of new irradiation techniques based on Co^{60} sources are discussed. (tr-auth)

6039 A/CONF.15/P/2235
ISOTOPY Tu^{170}, Eu^{155}, I Ce^{144} KAK ISTOCHNIKI ISLUCHENIYA DLYA KONTROLYA TONKOSTENNYKH ISDELII. (Tm^{170}, Eu^{165}, and Ce^{144} Isotopes as Radiation Sources for Controlling Thin-walled Wares.) S. V. Rumyantsev and L. N. Matsyuk (U.S.S.R.). 20p.

The physical properties of Tm^{170}, Eu^{155}, and Ce^{144} and the chief problems relating to their use for controlling thin-walled wares are discussed. The ionization constants of the isotopes studied are given as well as data characterizing self-absorption of the radiations in the sources and their attenuation on passing through metals. Because of self-absorption of the radiations, increasing the activity of the preparations (with constant specific activity) changes the radiation intensity per unit activity, as well as the spectral composition of the isotope radiations. (auth)

6040 A/CONF.15/P/2257
ON THE TRAINING OF PERSONNEL FOR ATOMIC

ENERGY IN ENGINEERING SCHOOLS IN COUNTRIES STARTING ATOMIC PROGRAMS. P. Ribeiro de Arruda (Univ. of São Paulo, Brazil). 6p.

Problems in procuring and training specialists in the field of nuclear technology are discussed. (C.H.)

6041 A/CONF.15/P/2264

BURMA'S ATOMIC ENERGY PROGRAM. Hla Nyunt (Union of Burma Atomic Energy Center, Rangoon). 18p.

The Union of Burma Atomic Energy Center was established in February 1955. The aims and objectives are to keep Burma abreast with world wide atomic developments, to train Burmese personnel in atomic energy, to do research in atomic sciences and its applications, to do prospecting, assaying, and processing of all source materials which might be available in Burma, to advise the Government on all matters relating to atomic energy, to control all isotopes, fissionable, and source materials, etc. Burma plans to continue and intensify the survey of the country's possible supply of uranium and thorium ores, to establish a nuclear laboratory equipped to handle radioisotopes for use in research in various fields of applications, and to start a small research reactor program. (auth)

6042 A/CONF.15/P/2265

BURMA'S ELECTRIC POWER NEEDS AND RESOURCES. San Shin (Union of Burma Electricity Supply Board, Rangoon). 31p.

The power consumption and resources of Burma are reviewed. The prospect of using atomic power generation in Burma will depend not only on the comparative cost of generation of electricity from this and some other alternative power sources but also on technical and fuel availability considerations. Available information indicated that the capital cost of nuclear station is £ 250 to £ 350 per kw depending upon the type of reactor, against £ 80 per kw of coal-burning stations. As coal, oil, and hydropower can meet the power requirements for some years to come, careful economic study will be necessary before going in for atomic power generation. Even if oil and coal are to be consumed, there still remains 2 to 3 million kilowatts of hydroelectric power to be developed. Apart from the economics of power generation, Burma has to face difficulties in having sufficient trained personnel in this field of engineering for construction, operation, and maintenance of nuclear power stations. However, as nuclear science progresses and Burma has more trained personnel, the whole power supply problem of Burma will have to be reviewed in the light of recent developments. (auth)

6043 A/CONF.15/P/2308

PRIMENENIE RADIOAKTIVNYKH IZOTOPOV V SSSR. (Production and Application of Radioactive Isotopes in the USSR.) A. V. Topchiev, I. T. Alad'ev, and P. S. Savitskii (Savitsky) (U.S.S.R.). 39p.

A survey of the production and application of radioisotopes in the U.S.S.R. is presented. The results of the use of radioisotopes in prospecting and production control and in metallurgical, chemical, textile, and food industries are emphasized. The economic efficiency of some isotopes is analyzed. New data which were obtained in various scientific fields where isotopes are used are presented. 89 references. (J.S.R.)

6044 A/CONF.15/P/2322

NEKOTRORYE TEKHNICHESKIE I TEKHNOLOGICHESKIE ASPEKTY PROIZVODSTVA RADIOAKTIVNYKH IZOTOPOV I MECHENYKH SOEDINENII V SSSR. (Some Engineering Technological Aspects of Radioisotope and Labeled Compound Production in the U.S.S.R.) V. V. Bochkarev, E. E. Kulish, and I. F. Tupitsin (U.S.S.R.). 36p.

The basic engineering and technological aspects of radioisotope production by neutron irradiation in reactors are discussed. The mass production of labeled compounds from the available radioisotopes is based on laboratory methods. Examples of practical applications of basic technological methods both in isotope and labeled compound production are given. The remote control equipment used is described. (J.S.R.)

6045 A/CONF.15/P/2335

TRAINING OF NUCLEAR TECHNICIANS IN SPAIN. A. Duran and F. Pascual (Junta de Energía Nuclear, Madrid). 5p.

The training of technicians in the field of nuclear energy in Spain is described. The courses offered in the universities are described. (W.L.H.)

6046 A/CONF.15/P/2336

THE NUCLEAR ENERGY PROGRAM AND ENERGY PROBLEMS IN SPAIN. José M. Otero (Junta de Energía Nuclear, Madrid). 22p.

The development of electrical energy production in Spain is discussed. The development of nuclear power plants is presented. (W.L.H.)

6047 A/CONF.15/P/2345

DECONTAMINATION AND POTABILIZATION OF THE WATERS OF THE RIVER PLATE FOLLOWING ACCIDENTAL CONTAMINATION BY FISSION PRODUCTS. Leopoldo José Anghileri (Comision Nacional de Energia Atómica, Buenos Aires). 36p.

Tests were carried out to demonstrate the decontamination of the River Plata water in case of an accident. The investigation consisted of adding a known quantity of radioactive substance to the water, subjecting it to the chosen process, and determining what amount of radioactive material was eliminated from the liquid. The three decontamination techniques tested were decontamination with coagulant, precipitation with Na_3PO_4 and NaOH, and precipitation of $(HO)_3Fe$. (W.D.M.)

6048 A/CONF.15/P/2415

THE DEVELOPMENT OF THE INTERNATIONAL COOPERATION BY THE U.S.S.R. IN THE PEACEFUL USES OF ATOMIC ENERGY. V. Yemelyianov (U.S.S.R.). 13p.

Activities of the Soviet Union since 1955 for the development of international cooperation in peaceful uses of atomic energy are summarized. Research activities and training programs are outlined. (C.H.)

6049 A/CONF.15/P/2416

ATOMIC POWER AND THE PORTUGUESE POWER PRODUCTION SYSTEM. J. S. Sabino Domingues, A. B. Couto Soares, and F. L. V. Soares David (Portugal). 9p.

The present conditions and characteristics of the power production industry in Portugal, which is mostly hydroelectric, are described. On generally accepted estimates the evolution of demand up to 1975 and the resources to meet this demand are discussed. An attempt is made to anticipate the part nuclear power will play in the next few years. (W.D.M.)

6050 A/CONF.15/P/2416(Rev.1)

THE PROBLEM OF THE PRODUCTION OF ELECTRICAL ENERGY IN PORTUGAL AND NUCLEAR POWER STATIONS. J. S. Sabino Domingues, A. B.

Couto Soares, and F. L. V. Soares David (Portugal). 11p.

The power production situation in Portugal is reviewed, and it is tentatively concluded that some nuclear power will be needed by 1975. Allowing five years for experience and another five for design and construction, it appears that 1965 can be fixed as the year to begin operations on the first industrial nuclear power project. (W.D.M.)

6051 A/CONF.15/P/2423
POSSIBILITIES OF TRAINING NUCLEAR ENGINEERING PERSONNEL IN CHILE. Ricardo Cruz Coke and Carlos Martinoya Raggio (Chile). 9p.

The status of scientific and technical education in Chile is evaluated. The possibilities of training technical personnel in nuclear engineering are considered. (C.H.)

6052 A/CONF.15/P/2460
VOZMOZHNOSTI PODGOTOVKI SPETSIALISTOV PO PROGRAMME STIPENDII MAGATE. (On the Opportunities for Training Specialists. The Scholarship Program.) V. V. Migulin (International Agency on Atomic Energy). 15p.

A report is presented on the International Atomic Energy Agency program of financial aid for training scientific and technical personnel. (R.V.J.)

6053 A/CONF.15/P/2520
PRODUCTION AND USE OF RADIOISOTOPES IN RESEARCH. U. N. Survey Paper. Henry Seligman ([Atomic Energy Research Establishment, Harwell, Berks, Eng.]). 8p.

The highlights of recent developments and trends of recent developments in the various research fields are touched upon. A survey is made of the papers on radioisotopes presented at the Geneva Conference. Almost half of the papers deal with the production of radioactive material in reactors or linear accelerators or by chemical enrichment. (W.D.M.)

BIOLOGY AND MEDICINE

6054 A/CONF.15/P/61
DOSIMETRY ASPECTS OF THE PRODUCTION OF BONE TUMOURS BY RADIATION. L. F. Lamerton (Royal Cancer Hospital, London). 15p.

Clinical and experimental data are reviewed on the induction by radiation of bone tumors in man and in experimental animals. It is pointed out that little information is available on bone tumor production following low-dosage exposures. Data are reported from studies on the uptake of phosphorus-32 in the bone of young rats in which the local dose rate was measured using thick-section radioautography. The need for studies on the relationship between tumor development and pre-existing tissue damage is discussed. (C.H.)

6055 A/CONF.15/P/64
THE USE OF GAMMA RADIATION TO DESTROY SALMONELLAE IN FROZEN WHOLE EGG. J. Brooks and R. S. Hannan (Cambridge Univ., Eng.), and Betty C. Hobbs (Central Public Health Lab., London). 7p.

Frozen whole egg (an intimate mixture of the white and yolk) is the most important egg product in international commerce. Average imports into the United Kingdom alone have amounted to about 22,000 tons per annum over the last ten years. It has been known for some time that egg products may contain members of the Salmonella group capable of causing food poisoning, but the position has been rendered more serious by the recent discovery of S. paratyphi B in egg products imported. In fact, the proved association of egg products with paratyphoid B fever has created a new situation in the epidemiology of the disease. After treatment of small samples of frozen whole egg with 2-Mev cathode rays, it was concluded that a dose of about 300,000 to 500,000 rads would destroy the numbers of salmonellas normally encountered in the product without impairing the baking qualities of the material. Whole tins, each containing 22 pounds, were therefore irradiated in the frozen state with cobalt-60 gamma rays. Two tins were treated at each of three dose levels of 300,000, 400,000, and 500,000 rads. The contaminants present before irradiation were S. paratyphi B (three tins), S. newport (two tins), and S. thompson (one tin). No salmonellas were detected in duplicate samples of material taken from each of the tins after irradiation. If the effectiveness of the treatment is confirmed by further work, the process has obvious attractions since it dispenses with the need to thaw or otherwise to handle the product. (auth)

6056 A/CONF.15/P/66
EXPERIMENTS ON THE IRRADIATION OF FISH WITH 4 MeV CATHODE RAYS AND COBALT 60 GAMMA RAYS. J. M. Shewan (Dept. of Scientific and Industrial Research, Aberdeen, Scot.) and J. Liston (Univ. of Washington, Seattle). 16p.

Results are discussed of two recent experiments designed to test the usefulness of irradiation in fish preservation. In the first, in which a 4-Mev cathode-ray apparatus was used, a variety of species, haddock, cod, ling, lemon sole, mackerel, and herring including kippers, was treated at doses from 0.25 to 3.5 million rads, and the effect on the sensory characteristics of the fish was assessed by a trained taste panel. It was concluded that low dose levels were the most suitable for fish, cod and lemon sole being the least affected. In the second experiment, only cod fillets packed in polythene bags were used, these being irradiated with a cobalt−60 source at levels of 0.25, 0.5, and 1.0 million rads. One additional batch of fillets, irradiated at 0.25 million rads, was dipped in 20 ppm of chlortetracycline for 30 minutes prior to irradiation. Control and irradiated fillets were stored at both 0° and 15°C, and samples were examined by the sensory, chemical, and bacteriological methods usually employed to follow the spoilage changes in stored fish. The most significant feature of the results was the enhanced effect produced by the combined antibiotic and irradiation treatments. Thus after 2 days at 15°C only the latter fish were acceptable to the taste panel, while at 0°C the controls were approaching inedibility 9 days after irradiation, and those subjected to 0.25, 0.5, and 1.0 million rads by the 13th day. The irradiated, antibiotic-dipped fish, on the other hand, were still edible on the 23rd day. There seemed, however, to be little correlation between these sensory changes and the chemical data (the amounts of total volatile bases and trimethylamine in the flesh). The numbers of bacteria on the surfaces of the fish were at first considerably reduced by irradiation. After two days at 15°C, however, the counts were as high in the irradiated fish as in the controls, only the antibiotic-irradiated samples remaining low. Similar results were obtained at 0°C. Thus both initially and during storage the controls had counts of about 10^6 to 10^7 per sq cm of surface. The irradiated samples at the beginning of storage had values of less than 10^3 per sq cm,

but these increased during the 23-day storage period to about 10^8 per sq cm while the samples subjected to both irradiation and the antibiotic never exceeded 10^6. Qualitative analyses of the flora showed that irradiation produced a marked reduction in the Pseudomonas types present, and since these are believed to be mainly responsible for spoilage, it is perhaps not surprising that the combination of antibiotic and irradiation should result in such enhanced keeping quality. (auth)

6057 A/CONF.15/P/67
PRINCIPLES UNDERLYING THE THERAPEUTIC USE OF MEGAVOLTAGE RADIATION. Ralston Paterson (Christie Hospital, Holt Radium Inst., and Medical Research Council Betatron Group Project, Manchester, Eng.). 16p.

General principles governing the clinical use of megavoltage radiation are reviewed. Experiences gained in three years use of a 4-Mev linear accelerator and of a 20-Mev betatron are discussed. The advantages of megavoltage over conventional therapy are summarized. (C.H.)

6058 A/CONF.15/P/68
A TECHNIQUE FOR PITUITARY ABLATION BY THE INSERTION OF RADIOACTIVE SEEDS. Frank Ellis, George Jackson, Charles L. Lewis, Anthony Nias, and Raymond Oliver (United Oxford Hospitals). 15p.

A technique is described for the insertion of gold-198 seeds into the pituitary gland which induces complete pituitary ablation. (C.H.)

6059 A/CONF.15/P/70
THE USE OF CARBON-14 LABELLED AMINO ACIDS FOR DETECTING PROTEIN SYNTHESIS IN SUB-CELLULAR PARTICLES OF MAMMALIAN TISSUES. P. N. Campbell and Olga Greengard (Middlesex Hospital, London). 16p.

A search was made for a simple biological system for the study of protein synthesis. Preparations were made of subcellular fractions from tissues involved in the synthesis of the specific proteins of interest. The energy-dependent incorporation of carbon-14 labeled amino acids into the specific proteins was used as a criterion for the synthesis of protein by the cell preparations. When microsomes isolated from regenerating rat liver were incubated with labeled amino acids in the presence of a suitable source of energy the serum albumin contained within the microsomal membrane became radioactive. Results are compatible with the hypothesis that isolated liver microsomes are able to synthesize a specific protein, but further work is needed to test this hypothesis. (C.H.)

6060 A/CONF.15/P/77
BIOLOGICAL STUDIES WITH LABELLED AMINO ACIDS AND PROTEINS. A. S. McFarlane (National Inst. for Medical Research, London). 11p.

Results are summarized from recent in vivo studies which employed amino acids and proteins labeled with carbon-14 or sulfur-35 for investigations of the anabolism and catabolism of proteins. (C.H.)

6061 A/CONF.15/P/90
NEW MEDICAL AND CHEMICAL RESEARCH IRRADIATION UNITS. D. S. Beard and G. Munday (Nuclear Engineering Ltd., London). 20p.

Two new gamma-ray therapy units are described which utilize radioactive Cs^{137} and Co^{60}. The first of these makes use of up to about 100 or 200 curies of Cs^{137} and is intended for the treatment of tumors lying within about 5 cm from the skin. For such tumors it is desirable that the dose should decrease rapidly with depth and that an excessive dose should not be given to the skin. By utilizing depleted uranium in the form of a small beam shaping nozzle it is possible to use a minimum source-to-skin distance of 4 cm in order to achieve the desired effect. Treatments at distances up to 10 or 15 cm may also be carried out in reasonable times using the more intense sources. In order to achieve an improvement in the uniformity of dose across the treatment field, particularly at very short distances, the source may be fabricated in the form of a ring. This unit is particularly suitable for treatment of tumors in the head and neck and sites normally difficult of access with the larger radium and cobalt units. The new cobalt unit was designed to allow both short and medium distance teletherapy to be carried out with the same machine. Two sources are contained within the main storage head: one may be up to 100 curies in strength and the other up to 500 or 1,000 curies. Either source may be selected and moved into a tungsten alloy treatment nozzle attached to the storage head. A minimum treatment distance of 10 cm may be obtained at either of two treatment ports in the nozzle. Clip-in applicators or an adjustable diaphragm may be used with the unit which may be supported in any suitable gantry. A unit designed specifically for chemical research under irradiation from source of Co^{60} of up to 10,000 curies is also described. (auth)

6062 A/CONF.15/P/92
THE ANTE-PARTUM ASSESSMENT OF PLACENTAL FUNCTION USING RADIOACTIVE SODIUM. C. G. Clayton (Atomic Energy Research Establishment, Harwell, Berks, Eng.) and G. T. Johnson (Park Hospital, Manchester, Eng.). 21p.

Assessment of placental function by orthodox methods of biochemical and clinical investigation is impracticable by reason of the obscure location of the placenta, but the recent introduction of radioisotopes to problems of practical obstetrics suggests a safe and usable technique, by observing the transfer of radioactively labelled sodium ions from mother to foetus with a suitably designed scintillation counter located over the pregnant uterus. The radiosodium is injected intravenously into the mother and the accumulation in the foetus observed. The chief difficulty is to differentiate between radiation level at a point above the abdomen immediately following maternal injection and that when equilibrium concentration of radiosodium prevails between mother and foetus. Factors affecting this problem are the size of the mother and foetus, choice of isotope, placental transfer efficiency and the design of the detector. The influence of each of these factors, which have been considered by calculation and measurement based on a simple model, is discussed, and some results obtained from investigations of normal and abnormal pregnancies are presented. (auth)

6063 A/CONF.15/P/93
STUDIES ON THE VERY EARLY DISTRIBUTION OF ^{45}Ca IN THE TISSUES AND SKELETON OF THE MOUSE. K. Dawson, E. O. Field, J. E. Gibbs, and M. M. Gwyther (Royal Cancer Hospital, London). 14p.

The distribution of calcium-45 in the body at short intervals after intravenous injection was investigated in mice by the low-temperature autoradiographic technique. To correct for effects due to different degrees of vascularization, a control series of mice was given

sulfur-35 labeled thiosulfate. Although calcium and thiosulfate ions in general behave very similarly in their extra-skeletal distribution, the higher renal clearance rate of thiosulfate resulted in a relatively higher concentration of this material in the kidney. The rate of exchange with skeletal calcium was consistent with rates deduced from analyses of plasma clearance curves for a rapidly exchangeable bone fraction. (auth)

6064 A/CONF.15/P/96
THE DOSE-RESPONSE RELATION FOR THE INDUCTION OF LEUKAEMIA BY WHOLE-BODY IRRADIATION OF MICE. R. H. Mole (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 10p.

Data are tabulated on the incidence of leukemia in mice exposed to various doses of fast neutrons and x and gamma radiation. Factors involved in the leukemogenic process are discussed. Factors to be considered in extrapolating the findings to radioinduced leukemia in man are also discussed. (C.H.)

6065 A/CONF.15/P/97
SPONTANEOUS AND INDUCED CHANGES IN CELL POPULATIONS IN HEAVILY IRRADIATED MICE. D. W. H. Barnes, C. E. Ford, S. M. Gray, and J. F. Loutit (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 16p.

The hemopoietic and lymphopoietic tissues of established homologous and heterologous radiation chimeras may revert spontaneously from donor type to host type. This reversion may stem from very few cell clones, many of which can be identified cytologically by the presence of characteristic chromosomal re-arrangements in mitotic cells. Other homologous radiation chimeras may be very stable in that the donor tissue persists and spontaneous reversion does not occur. Transpopulation of these hemopoietic and lymphopoietic tissues back to host-type tissue was induced by the intravenous injection of spleen, but not so far by lymph node, cells isologous with the host. It is concluded that both spontaneous reversion and induced transpopulation are due to the superior physiological competence of the finally predominating cell-line rather than mastery through a reaction of immunity. The findings are interpreted as further evidence of the common ancestors of myeloid and lymphoid cells. (auth)

6066 A/CONF.15/P/98
CHROMOSOMES AND CARCINOGENESIS: OBSERVATIONS ON RADIATION-INDUCED LEUKAEMIAS. C. E. Ford and R. H. Mole (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 20p.

Morphological observations on chromosomes in 64 cases of radioinduced and spontaneous leukemia are described and illustrated. The majority of primary reticular neoplasms showed variations in chromosome number and characteristics which were maintained on continued transplantation. No fundamental cytogenetic differences were observed between neoplasms arising in irradiated and non-irradiated mice. The relationship of cytogenetic changes to carcinogenesis is discussed. (C.H.)

6067 A/CONF.15/P/109
DELAYED EFFECTS OBSERVED IN RATS SUBJECTED TO A SINGLE DOSE OF X-RAYS. J. Maisin, A. Dunjic, P. Maldague, and H. Maisin (Univ. of Louvain, Belgium). 21p.

Data are reported which indicate that the shortening of the survival time in animals irradiated with a dose of 600 r (LD50/30) over the whole of the body is a consequence of various mechanisms. It is suggested, following partial irradiation of the head, of the thorax, and of the abdomen with increasing doses of x rays, that these mechanisms may be ascribed to lesions or functional alterations of the tissues of organs of the head, thorax, and abdomen. (auth)

6068 A/CONF.15/P/110
EFFET CARCINOGENETIQUE CHEZ LE RAT BLANC D'UNE DOSE UNIQUE DE RAYONS X. (Carcinogenic Effect of Single Doses of X-Rays in the White Rat.) J. Maisin, P. Maldague, A. Dunjic, Pham-Hong-Que, and H. Maisin (Univ. of Louvain, Belgium). 26p.

The carcinogenic effects of single doses of radiation of varying orders of magnitude were studied in a homozygous stock of white rats. A single dose of whole-body radiation was administered to several series of rats. Its order of magnitude was LD_{50} for unprotected animals and from 700 to 1000 r for the rats protected by mercaptoethylamine or by some method of mechanical protection. The mean incidence of cancer increased from 2.82 to 7.1% and went to 16% for some types. A large variety of cancers other than leukosarcomas was induced. Every variety of epithelial cancer found in man was reproduced. All kinds of sarcoma were also observed. In further experiments the irradiated area was reduced to 4 cm × 2 cm at a dose of 850 r. The number of cancers increased in comparison with the control groups. In the group irradiated in the median abdominal region, the incidence of cancer was 20%, compared to 2.82% in the control group. The incidence was 5% for animals irradiated in the thorax. The possible mechanism of carcinogenesis by a single moderate dose is discussed. (J.S.R.)

6069 A/CONF.15/P/111
DISTURBANCE OF THE ION TRANSPORT ACROSS THE IRRADIATED SKIN OF AMPHIBIANS. G. van der Schueren and J. Bonte (Univ. of Louvain, Belgium). 38p.

Disturbances of water and electrolyte flux across the ultraviolet irradiated skin of Rana temporaria were investigated with the aid of sodium-24 and potassium-42. The radioisotopes were added to the water in which the animals were maintained. The equipment and procedures are described. From the results it was concluded that the lethal effect on Rana temporaria of ultraviolet light is accompanied by negative transcutaneous sodium and potassium flux which is essentially due to an increased outflow. Administration of sodium, lower temperatures, or exposure to visible light reduced the lethal effect. (C.H.)

6070 A/CONF.15/P/114
ETUDE AUTORADIOGRAPHIQUE DE CHROMOSOMES. (Autoradiographic Study of Isolated Chromosomes.) A. Ficq and C. Pavan (Univ. Libre de Brussels and Univ. of Sao Paulo, Brazil). 6p.

The uptake of specific radioactive precursors of nucleic acids and proteins was studied in salivary gland chromosomes of Rhynchosciara angelae during larval growth. 0.01 to 0.1 μ c of thymidine-H^3, adenine-8-C^{14}, and phenylalanine-2-C^{14} were administered. In most cases the animals were sacrificed after 24 hours. Certain bands, and particularly the "puffs," exhibit a high level of radioactivity after thymidine injection. It was confirmed that the radioactivity observed was caused by desoxyribonucleic acid. To study the general metabolism of the chromosome as a function of the metabolic variations of ribonucleic acid, adenine and phenylalanine were administered. The results

show that ribonucleic acid and proteins also play an important role in the formation of "puffs." A concurrent study of the metabolism of desoxyribonucleic acid and chromosome proteins confirms that the "puffs" show a very high incorporation of the two precursors, indicating a concomitant synthesis of RNA and proteins at this level. (J.S.R.)

6071 A/CONF.15/P/115
INFLUENCE DE LA NATURE DU VEGETAL ET DE LA QUANTITE DE PHOSPHATE APPLIQUEE SUR LE DEGRE D'UTILISATION DE PHOSPHATES MARQUES. (Effect of the Nature of the Plant and Amount of Phosphate Applied on the Degree of Utilization of Tagged Phosphates.) A. Van Den Hende and A. Cottenie (Inst. Agronomique, Ghent). 13p.

The effect of the nature of the plant on phosphate utilization was studied in four widely different soils with oats, ryegrass, clover, and maize. A determination of the total P_2O_5 and radioactivity following harvesting showed that, while the degree of utilization of the tagged $CaHPO_4$ by the plant varied from one soil to the next, it was practically the same for the four species under study. The effect of increasing the doses of phosphates on utilization by the plant is quite different. The tests, carried out under the same conditions as the experiments on the different species, showed that utilization of the nutrient salt by the plant increases markedly for a given soil when the dose of $CaHPO_4$ is larger. (J.S.R.)

6072 A/CONF.15/P/116
UTILISATION DU Ca PAR LA PLANTE A PARTIR DE DIFFERENTES COMBINAISONS MARQUEES. (Ca Utilization by Plants as Determined with the Help of Various Tagged Compounds.) A. Van Den Hende and A. Cottenie (Inst. Agronomique, Ghent). 14p.

A tracer study in twelve soils of widely differing natures and acidity was made of Ca utilization by plants from hydrated CaO, $CaCO_3$, and $CaSO_4$. Tests made on oats sowed shortly after the addition of Ca and harvested after 12 weeks showed that the degree of utilization of $CaCO_3$ and CaO had no significant difference in strongly acid soils. In the soils with KCl pH < 7 the coefficient of utilization of $CaSO_4$ is significantly lower than that of CaO and $CaCO_3$. The results show that the utilization by the plants of CaO and $CaCO_3$ can be very high in certain cases (up to 78.7% for a sandy-muddy soil with a KCl pH of 4.00). A comparison of the results of the determination of the utilization coefficients with the initial KCl pH of the soil as well as with the complex of adsorption of the soil shows a very high correlation. (J.S.R.)

6073 A/CONF.15/P/117
L'AUTORADIOGRAPHIE DANS LES RECHERCHES DE PHYSIO-PATHOLOGIE DES OS. (The Use of Autoradiographs in Physio-Pathological Research in the Field of Osteology.) P. Lacroix (Univ. of Louvain, Belgium) and R. Ponlot (Inst. Interuniversitaire des Sciences Nucléaires, Brussels). 6p.

The redistribution of Ca^{45} in the adult skeleton of the dog, studied by autoradiography, is approximately the same as in the growing skeleton, but much slower. The autoradiograph made ten hours and 42 days after the administration of Ca^{45} is compared with microradiographs and microphotographs made at the same time. The value of autoradiography in osteological investigations is discussed. (J.S.R.)

6074 A/CONF.15/P/118
INHIBITION DE LA SYNTHESE DES PROTEINES PAR L'AZAGUANINE CHEZ BACILLUS CEREUS. (The Inhibition of Protein Synthesis in Bacillus Cereus by Azaguanine.) H. Chantrenne and S. Devreux (Univ. Libre de Brussels). 2p.

The compound 8-azaguanine, which incorporates itself into ribonucleic acids in place of guanine, is a general protein synthesis inhibitor. The mode of action of azaguanine on B. cereus offers several points of analogy with that of chloramphenicol on E. coli. The use of azaguanine-2-C^{14} and of various tagged amino acids made it possible to analyze the mode of action of the compound (azaguanine) and to compare it with that of chloramphenicol. (auth)

6075 A/CONF.15/P/120
LA CAPTATION THYROIDIENNE D'I^{131} CHEZ L'HOMME APRES ADMINISTRATION DE TRI-IODOTHYRONINE. (I^{131} Capture in Man Following the Administration of Tri-iodothyronine.) J. A. Henry, G. Derome, P. Dor (Univ. Libre de Brussels); and J. Mahaux (Hopital Brugmann, Brussels). 7p.

As some euthyroid patients have high iodine uptake by the thyroid, an investigation was made to determine if the administration of l-triiodothyronine causes modifications in iodine uptake which can be used to establish if the thyroid function is normal or pathological. Triiodothyronine was administered to subjects whose rate of iodine capture was high but whose thyroid function was normal, and to hyperthyroid patients. In the euthyroid patient, iodine uptake, 24 hours after the administration of triiodothyronine, was reduced by an average of 33%. The variation of iodine uptake in the hyperthyroid patient was insignificant. The age of the patients has no effect on the variations in the rate of iodine uptake after triiodothyronine administration. (J.S.R.)

6076 A/CONF.15/P/122
MISE EN EVIDENCE D'UNE ACTION SPECIFIQUE DE L'HORMONE THYROIDIENNE SUR LE METABOLISME DU PHOSPHORE "IN VIVO." (Demonstration of a Specific Action of the Thyroid Hormone on the In Vivo Metabolism of Phosphorus.) A. M. Ermans (Inst. Interuniversitaire des Sciences Nucléaires, Brussels and Univ. Libre de Brussels). 7p.

A study was made in the intact cell of the effect of thyroid hormone on the transfer of the phosphate ion through the membrane of the erythrocytes. The investigation was made by measuring the rate at which radiophosphorus was leaving the tagged erythrocyte at various stages of thyroid impregnation, both in man and rats. The concentration of the acid-soluble phosphorus in the red cells and the basal metabolism were determined. The increase in the basal metabolism in hyperthyroid humans and rats is associated with a significant increase in the rate at which P^{32} is leaving the erythrocytes. This rate is reduced in human myxedema and in the rat after administration of a thyroid inhibitor. The concentration of the acid-soluble phosphorus undergoes only small modifications. It was established that the rate at which phosphate escapes through the cell membrane varies with the thyroid activity. (J.S.R.)

6077 A/CONF.15/P/123
MODIFICATIONS DE CROISSANCE DUES AUX RAYONS X. (Alterations in Growth Due to X-Rays.) J. Moutschen (Univ. of Liège). 16p.

If dry barley grains are subjected to x radiation, the length of the coleoptiles is affected. All mitoses are inhibited by 200 kr. A study was made of the effect of various factors on this elongation. It is increased by prior hydration of the grain and by low and high temperature treatment. Long latency periods between irradiation and germination will suppress the phenomenon. Latency times of over 20 days accentuate mitotic inhibition and reduce coleoptile elongation. Reduced glutathione and cystamine have an effect comparable to a latency time of 20 days. In the case of cryptogamous plants, the increase in elongation could be attributed to the induction of adaptative enzymes in response to the action of the radiation. (J.S.R.)

6078 A/CONF.15/P/130
MUTATIONS IN RICE INDUCED BY X-RADIATION. T. Y. Ouang and W. T. Chang (Taiwan Provincial Coll. of Agriculture, Taichung, China). 9p.

The dormant seeds, germinating seeds, and spikes of several rice varieties were exposed to a range of x-ray doses. Data are tabulated on morphological and genetic changes induced in succeeding generations. Chromosomal aberrations and gene mutations were considered to be the major causes of the variations observed. (C.H.)

6079 A/CONF.15/P/131
THE EFFECT OF RADIATION ON THE FIRST IRRADIATED GENERATION OF SWEET POTATO AND PEANUT. Chung-Fu Cheng (Joint Commission on Rural Reconstruction, Taiwan, China). 6p.

From the preliminary planting of x-ray-treated tubers of a sweet potato variety, one plant had been found to mature earlier and yield significantly better than the original and another to have a light skin color instead of the original white. Both of these two plants were obtained from the tubers previously treated with 5000 r of x rays. In peanuts, two varieties were treated with thermal neutrons at intervals of 120, 170, and 220 minutes and with x rays at dosages of 15,000 r and 20,000 r. Preliminary results from the first irradiated generation showed that radiation has certain detrimental effects on germination, growth, and fertility of plants. However, some favorable gene mutations do occur and create additional material for further selection. Some plants from thermal neutron or x-ray-treated seeds were found to be more productive than the control. (auth)

6080 A/CONF.15/P/133
I-131 THYROID UPTAKE STUDY OF ENDEMIC GOITER IN TAIWAN, CHINA. Tien-cheng Kao, Kuang-chu Wang, et al. (National Taiwan Univ., Taipei, China). 8p.

The thyroid uptake of iodine-131 was measured in populations in regions of endemic goiter. An analysis of the data indicates a high uptake of iodine-131 in people from an endemic area, with the uptake highest in the younger age group. Hypothyroidism was observed only in the older age group. (C.H.)

6081 A/CONF.15/P/164
AUTORADIOGRAPHIC STUDIES ON THE DISTRIBUTION OF LABELLED DRUGS IN THE BODY. Sven Ullberg (Kungl. Veterinärhögskolan, Stockholm). 16p.

An autoradiographic method was developed which has proved well suited for drug distribution studies. This method makes it possible to obtain survey autoradiograms from thin sections of large specimens, e.g., sagittal sections from whole adult mice, rats, or guinea pigs. The animals are sacrificed at different times after administration of the labeled drug by immersion in CO_2-acetone at −78°C and mounted in ice on block holders to a heavy microtome in a freeze room at −10°C. To get whole sections, adhesive tape is fastened onto a cutting surface of the block before sectioning the tape holding the section together. Sections can be made through undecalcified hard tissues such as bone and teeth. It was possible to get whole 20μ-sections from heads of rhesus monkeys with teeth in situ. The sections are dehydrated at −10°C and the autoradiographic exposure is made by apposition at the same temperature. The labeled substances that are dissolved in body fluids will in this way be registered on the autoradiograms without dislocation. In pregnant animals the isotope concentration can be studied in the fetus, the fetal fluids, the placenta and the maternal tissues on the same autoradiogram. For complementary localizations on a cellular level, a modified technique has been used. From small freeze-dried tissue pieces tape sections, about 20μ thick, are taken which are then permanently attached to a suitable emulsion by dry mounting. The problems which have so far been most thoroughly investigated are the distribution of some antibiotics and chemotherapeutic agents. Among others the following substances have been studied (the method of labeling in brackets): S^{35}-penicillin (biosynthesis), H^3-dihydrostreptomycin and H^3-tetracycline (catalytic hydrogenation), C^{14}-paraaminosalicylic acid (P.A.S.) (chemical synthesis), and H^3-P.A.S. (radiation-induced labeling. Wizbach's method). The method has also provided possibilities for studying the different ways of excretion. The distribution after local application, e.g., in the eye after application of the labeled drug in the conjunctival sac and in normal and mastitic udders after application in the teat canal, has also been studied. The technique has also been used for studying the distribution of S^{35}-promethazine and radiotherapeutic agents. It has also proved suitable in work with short-lived isotopes such as fluorine-18 with the half life of 112 minutes. (auth)

6082 A/CONF.15/P/169
EXPERIMENTS ON THE INFLUENCE OF SELECTION PRESSURE ON IRRADIATED POPULATIONS OF DROSOPHILA MELANOGASTER. Gert Bonnier, Ulla-B. Jonsson, and Claes Ramel (Univ. of Stockholm). 3p.

It may be supposed that the social level and the level of medical care in human populations is of influence upon the genetical consequences of irradiation of these populations. In order to study this question, model experiments with Drosophila melanogaster were started towards the end of 1956. Flies of experimental populations are for each generation given an acute x-ray dose of 1.5 kiloroentgens. From eggs laid thereafter freshly hatched larvae are collected and transferred to vials with a standard amount of food where the larvae develop. The number or larvae thus transferred is different in different populations; in some only 25 larvae, in others 200 larvae. In the former type there is practically no competition for food, but this competition is strong in the latter type. Besides this control of selection pressure there is, in other populations, also a control that individual females do not contribute more than a limited number of progeny for the next generation. All populations emanate from a common non irradiated homozygous strain. Genetical differences which later are found between the populations may therefore primarily be ascribed to the differences in selection pressure. In all these populations there occurred, in the beginning, difficulties to keep them alive. With increasing number of generations these difficulties were rather soon overcome in the populations with strong selection

pressure. In the populations with low selection pressure the situation was much more grave: at one moment it seemed as if extinction was imminent in one of these populations. However, when a certain amount of accumulated dose was surpassed, the viabilities of the low-pressure populations increased to a level close to that of the high-pressure populations. Flies are randomly collected from the populations prior to the irradiation of the populations. With these flies, which thus are, themselves, nonirradiated, different kinds of tests are made. These tests include larval competitions, egglaying capacity, egg hatchability, fertility of males, frequency and spread into the populations of bad genes. So far no clearcut picture is arrived at from these tests. Several more generations must elapse before valid conclusions can be drawn. (auth)

6083 A/CONF.15/P/170
BLOCKING OF THE RECOVERY OF CHROMOSOME BREAKS INDUCED IN DROSOPHILA MELANOGASTER SPERM. K. G. Lüning (Univ. of Stockholm). 6p.

The effect of oxygen concentration on the mutagenic effectiveness of x radiation was investigated in Drosophila sperm. Data are tabulated. Data are consistent with the hypothesis that there is a rejoining of broken chromosome ends and that this occurs between 30 and 40 minutes after irradiation at anoxia. (C.H.)

6084 A/CONF.15/P/171
THE DETERMINATION OF Sr^{90} AND OTHER β-EMITTERS IN HUMAN BEINGS FROM EXTERNAL MEASUREMENTS OF THE BREMSSTRAHLUNG. K. Lidén (Univ. of Lund). 30p.

Applications of bremsstrahlung measurements for in vivo localization of beta-emitting radioisotopes following administration to human patients are discussed. A scintillation spectrometer technique was used for counting. The gross distribution of phosphorus-32 tracers in the body was followed by manual scanning. It was possible to detect a significant uptake of phosphorus-32 in small sections of the skeleton and in organs where metastatic tumor lesions were suspected. The possibility of using the method for quantitative determinations of small amounts of strontium-90 in human beings and the precision of the measurements are discussed. (C.H.)

6085 A/CONF.15/P/175
METABOLISM OF STRONTIUM 90 IN LACTATING AND PREGNANT GOATS. Lars Ekamn and Bertil Åberg (Royal Veterinary Coll., Stockholm). 12p.

Data are tabulated on the distribution of strontium-90 in lactating and pregnant goats, milk, and fetuses following the administration of single and multiple oral doses of strontium-90. Excretion and retention data are discussed. Strontium-90 was readily taken up in many tissues of the fetus, especially those containing calcium. Strontium-90 was found to accumulate in the udder before milk excretion started and thus affected the activity of first milk. (C.H.)

6086 A/CONF.15/P/214
COBALT-60 BEAM THERAPY. Ivan H. Smith, J. C. F. MacDonald, et al. (Ontario Cancer Foundation, London, Can.). 32p. (AECL-624). $0.25(AECL).

Clinical experiences using the first commercially produced kilocurie cobalt-60 therapy unit are reviewed. Data cover a seven-year period. It is concluded that the physical advantages of high-energy gamma radiation over x rays in the conventional energy range are paralleled by clinical advantages. In radically treated cases, however, the initial tolerance of tumor tissue is slightly higher under the high-energy gamma irradiation. Encouraging results are reported in the treatment of intrinsic carcinoma of the larynx, esophagus, mouth, and bladder. Physical data are included for the Theratron Junior Hectocurie Cobalt-60 Unit which was designed for use at a 55 cm source-to-tumor distance and is suitable for limited circumaxial-rotation and arc therapy and for fixed-field therapy. (C.H.)

6087 A/CONF.15/P/215
INHALATION RADIOCARDIOGRAPHY. C. H. Jaimet, R. H. Tomlinson, et al. (McMaster Univ., Hamilton, Ont., Can.). 12p. (AECL-625). $0.25(AECL).

A technique is described for the investigation of several functions of the heart by means of radiocardiography. Good results were obtained in studies on heart circulation, and particularly that of the left heart and myocardium. Improved methods are reported for handling and administering tracer doses of methyl radioiodide aerosol by inhalation. Techniques were developed using radiokrypton which give information concerning myocardial circulation which cannot be obtained using methyl iodide. The paths of the inhaled radioisotope aerosols were delineated with the aid of a crystal scintillation counter, amplifiers, discriminator, rate meter, and pen recorder. Data are reviewed from studies of 150 normal cases and 20 patients with cardiopathy. Normal and abnormal graphs were readily distinguished. (C.H.)

6088 A/CONF.15/P/218
THE METABOLIC RESPONSE TO RADIATION IN THE PRIMATE. C. G. Hunter (Univ. of Toronto). 23p.

At present there is little information available concerning the metabolism of man following exposure to ionizing radiation in the lethal range. Reference is made in vague terms to the maintenance of fluid and electrolytes, the administration of a bland diet, intravenous glucose, salines etc., with little experimental evidence from primate studies to indicate the benefit of these modes of therapy. It is felt, therefore, that results of metabolic studies made in sub-human primates will be of therapeutic interest. Adult monkeys of both sexes were exposed to whole-body irradiation with x and gamma rays. The absorbed doses were in the sub-lethal and lower lethal range for monkeys (400 to 500 r), and were administered at rates varying from 7 to 124 r/min. Observations were made on eleven monkeys that were kept in metabolic cages before and after irradiation. The derangement of metabolism consequent to irradiation was studied. After physiological recovery of eight surviving animals, the experiment was repeated using identical dietary intake and experimental technique but omitting irradiation. Comparisons were then made between the results of the irradiation study and those obtained after physiological recovery. Data are presented on the clinical physiology of representative animals, including data on body weights, food and fluid intakes, urine and faecal outputs, insensible losses, metabolic rates, balances of water, nitrogen and electrolytes, nitrogen utilization, and caloric intakes. It is concluded that the metabolic response to radiation injury in the lethal range does not differ qualitatively in the primate from that of any injury and that the irradiated primate is not at a disadvantage until the time of anabolic response. At that time the tissues responsible for normal reparative processes, themselves injured by the radiation, are no longer able to perform normal restorative functions,

the resultant catabolism being in excess of that from equivalent injury from other causes. The implications of these studies on the clinical nutrition of the human exposed to sublethal doses of radiation are considered. (C.H.)

6089 A/CONF.15/P/220
ON THE EXCRETION OF STRONTIUM-90 AND CESIUM-137 BY THE HUMAN. C. G. Stewart, E. Vogt, A. J. W. Hitchman, and N. Jupe (Atomic Energy of Canada Ltd., Chalk River, Ont.). 27p. (AECL-630). $0.25(AECL).

Experimental evidence already obtained with uranium, plutonium, and radium indicates that the excretion rate may be expressed, more precisely than by the commonly used exponential model, with an equation of the form $y = at^{-c}$, where y is the amount of radioactivity excreted per day, t has the usual meaning of time, and c is a parameter characteristic only of the specific isotope. To assess the total radiation dose received within life expectancy from the rate of excretion of other radioisotopes, it is important to determine whether their excretion rates can be expressed by a similar relation and to determine characteristic values of c. The rate of excretion of Sr^{90} from two accidentally contaminated persons has been found to follow the relations $y = 20600\ t^{-1.20}$ and $y = 8200\ t^{-1.10}$, where y in each case is the daily excretion in urine of Sr^{90} expressed in $\mu\mu c$ at t days, and where the two cases were followed experimentally for 490 and 734 days, respectively. Similarly, the rate of excretion of Cs^{137} by one human was found to follow the relation $y = 4080\ t^{-0.53}$ for 386 days. The implications of an exponent with an absolute value greater than unity in the excretion-rate equation of Sr^{90} and less than unity in the excretion-rate equation of Cs^{137} are discussed in terms of evaluating the total radiation dose received by an individual within life expectancy. The coöperation of many laboratories in the collection of excretion-rate equations for radioisotopes would make it possible to obtain truly representative values of the parameter c in humans and permit accurate radiation-dose estimates on the basis of excretion analyses. (auth)

6090 A/CONF.15/P/234
FIRST 5-YEARS RESULTS OF ROUTINE INTRACAVITARY ADMINISTRATION OF COLLOIDAL RADIOACTIVE GOLD (Au^{198}) FOR THE TREATMENT OF OVARIAN CANCER. J. H. Muller (Univ. of Zurich). 15p.

A report is presented on the first 5-years results of routine intraperitoneal and intrapleural administration of colloidal radioactive gold (Au^{198}) for the treatment of ovarian cancer in an unselected group of 51 patients. These results indicate that such isotope administration is a true progress in the field of cancer therapy, since it does at least double the salvage rate of the ovarian cancer patients with surgically resectable primaries. (auth)

6091 A/CONF.15/P/237
ACTION MUTAGÈNE DE PETITES DOSES DE RAYONS X. (The Genetic Effect of Single or Divided Small Doses of X-Rays.). E. Guyénot, L. Thélin, and V. Kiortsis (Switzerland). 2p.

Preliminary results are reported from a study of the genetic effects in Drosophila of single doses and of divided doses of 20 and 40 r x radiation. The irradiation technique is described, and results are tabulated. (C.H.)

6092 A/CONF.15/P/241
CALCIUM UPTAKE IN IRRADIATED BONES. A. Zuppinger and W. Minder (Univ. of Bern). 7p.

The metabolism of calcium in irradiated bones was studied in rats following the administration of calcium-45. One leg of each rat was irradiated and the uptake of calcium-45 compared with that in the unirradiated leg. One week after irradiation with 200 r the calcium uptake was lowered by 62% in the irradiated and 75% in the non-irradiated leg. One week later the non-irradiated leg had recovered, while the irradiated one showed the same damage, and during the next six weeks the uptake slowly dropped to 53%. Results indicate that this dose of radiation exerts an indirect temporary effect and a direct long-lasting damage to bone. (C.H.)

6093 A/CONF.15/P/242
DISTRIBUTION PATTERN AND RETENTION OF ^{35}S-CYSTEAMINE IN MAMMALS. K. Lauber, A. Zuppinger, and H. Aebi (Univ. of Bern). 10p.

Data are presented on the tissue distribution and retention of cysteamine-S^{35} following injection to rats and mice. Cysteamine was shown to be metabolized quickly and excreted mainly in urine. Appreciable amounts of sulfur-35 were still eliminated after 10 days. Approximately 13 to 19% of the injected sulfur-35 was retained as taurine and sulfate. The remainder of the retained activity was bound to proteins, most of it in the form of mixed cysteamine-cystine-disulfide. The significance of the results is discussed in respect to the protective effects of cysteamine against radiation injury. (C.H.)

6094 A/CONF.15/P/243
NOUVEAU TRAITEMENT DES GLIOBLASTOMES CEREBRAUX PAR LE COBALT 60 APPLIQUE INTRACEREBRALEMENT, SUIVI DE SEANCES DE TELECOBALTOTHERAPIE (BOMBE AU COBALT). (A New Treatment of Brain Glioblastomata by Intra Cerebral Applications of Cobalt 60 Followed by Telecobalt Sessions (Cobalt Bomb).) Albert Jentzer (Geneva). 7p.

The technique for the treatment of brain glioblastomata by intracerebral application of Co^{60}, followed by cobalt bomb treatments, is described. Details of the clinical observation and the post-mortem results are given for one of the cases so treated. (J.S.R.)

6095 A/CONF.15/P/244
EFFICACITE BIOLOGIQUE RELATIVE DES RADIATIONS DE FREINAGE DE 400 KEV ET 31 MEV. (Relative Biological Effectiveness of Bremsstrahlung Radiation of 400 kev and 31 Mev Energy.) G. Joyet, M. Miller, and M.-L. Joyet (Univ. of Zurich). 25p.

The relative biological effectiveness of 400-kev and 31-Mev radiation was experimentally determined by three tests. Survival curves were obtained for male mice exposed to single doses of 600 to 1200 r. The decrease in the weight of the testicles of mice exposed to single doses of 60 to 80 r was determined. A comparison was made of the activities measured on the skin surface in human subjects exposed to 400-kev and 31-Mev radiation after an intravenous injection of P^{32}. The tests showed that at 31 Mev a slightly higher ionizing dose is necessary to obtain the same biological effect as at 400 kev. If the energy absorbed by the musculature is determined, it is found that an 11% ionization increase is needed. At equivalent absorption energies, the same biological effect is obtained. (J.S.R.)

6096 A/CONF.15/P/249
CONTRIBUTION A L'ETUDE DU METABOLISME DES ACIDES GRAS POLYETHYLENIQUES. (A Contribution

to the Study of the Metabolism of Polyethylenic Fatty Acids.) Karl Bernhard, Martin Rothlin, and Rudolf Wyss (Univ. of Basel). 6p.

The metabolism of oleic, linoleic, and γ-linolenic acids in rats deficient in the essential fatty acids was studied. The acids were labeled with C^{14}, and the degree of oxidation was determined by measuring the radioactivity of the exhaled carbon dioxide. The fatty acids were also isolated from the liver and the eviscerated animal to determine the possibility of the transformation of the ethylenic acids into saturated fatty acids. The results showed that the γ-linolenic acid oxidized most rapidly and linoleic acid least rapidly. In rats without the fatty acid deficiency, no characteristic difference was found in the radioactivity of the exhaled carbon dioxide. The study of the fatty acids in the liver and the body of the animals showed that the linoleic and γ-linolenic acids are not transformed into stearic acid in the organism. The formation of stearic acid by the hydrogenation of oleic acid occurs only to a very limited extent. (J.S.R.)

6097 A/CONF.15/P/258
SURFACE IRRADIATION AND ASEPTIC MUSCLE AUTOLYSIS. I. BIOCHEMICAL AND STRUCTURAL AUTOLYTIC MODIFICATIONS OCCURRING IN RABBIT, LAMB AND HOG IRRADIATED FRESH MUSCLES, DURING ASEPTIC AND ANAEROBIC STORAGE IN THE DARK AT 25° AND 37°C.
R. Zender, C. Lataste-Dorolle, et al. (Battelle Memorial Inst., Geneva). 31p.

Problems in the radiation processing of meat to allow storage at normal room temperatures are discussed. Factors affecting surface sterilization and enzymatic deterioration are considered. Methods are described for measuring the enzymatic autolysis of fresh meat. It is postulated that autolysis is an orderly phenomenon, controllable by heat, and possibly by specific biochemical treatment. Results are reported from studies in which nonirradiated muscles of lambs, rabbits, and hogs were stored in the dark in sealed glass vessels over alkaline pyrogallol solution for 100 days at 25°C and for 15 to 35 days at 37°C. Biochemical and morphological tests were made on samples of the meat. Samples were then irradiated with surface doses of 2-Mev electrons. Examination of fiber structures indicates a marked state of preservation. (C.H.)

6098 A/CONF.15/P/258(Add. 1)
SURFACE IRRADIATION AND ASEPTIC MUSCLE AUTOLYSIS. 2. FOOD PRESERVATION COMBINING THE EPINEPHRINE. ANTI-AUTOLYTIC EFFECT WITH SURFACE IRRADIATION. C. Radouco-Thomas, C. Lataste-Dorolle, et al. (Battelle Memorial Inst., Geneva). 32p.

Results are reported from a study of factors affecting the satisfactory storage of meat. Enzymatic autolysis and bacterial spoilage are chiefly responsible for meat deterioration. The anti-autolytic action of epinephrine administered ante-mortem and the combined effects of epinephrine and surface irradiation on the storage life of meat were investigated. Methods of treatment and testing are described, and results are presented graphically. (C.H.)

6099 A/CONF.15/P/276
RECENT RESEARCH IN BIOCHEMICAL APPLICATIONS OF LARGE RADIATION SOURCES WITH SPECIAL REFERENCE TO PHARMACEUTICAL PRODUCTS. T. Horne (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 11p.

The suitability of radiation as a means of sterilizing pharmaceuticals was investigated. The pharmaceuticals, all of British Pharmacopoeia of equivalent quality, were dispensed in ampoules in the form in which they are normally presented, and were treated with gamma radiation at two dose levels: 2.5×10^6 rad i.e. about that required for sterilization, and at a higher level 25×10^6 rad. It was found that the antibiotics, as a class, lost little in potency after a dose of 2.5×10^6 rad. The changes in many cases even at the higher dose level were within the limits of experimental error. The organometallic compounds examined were seriously affected by 2.5×10^6 rad. Mersalyl acid (dry powder) showed marked discolouration. Sodium antimonyl gluconate (dry powder) was discoloured and had an odour of caramel after 2.5×10^6 rad. Of the alkaloids studied, ergometrine maleate showed discolouration of the powder with a progressive lowering of the melting point. The injection solution was more adversely affected than the powder and the pH of the solution progressively increased. Assay of morphine sulphate following irradiation at 2.5×10^6 rad showed no apparent change, but a bright yellow colour developed. The injection solution also turned yellow, and showed a decreased optical rotation. Atropine sulphate was also discoloured and the apoatropine content was increased above the limits allowed by the British Pharmacopoeia. Procaine hydrochloride, the only local anaesthetic studied showed virtually no change on assay even after 25×10^6 rad, but developed a yellow-brown colour. Crystalline insulin showed a significantly lower potency after 2.5×10^6 rad. Hyaluronidase was also markedly decomposed at this level but heparin (powder) was not; a solution of heparin was more adversely affected. Simple injection of insulin and of protamine zinc insulin showed a fall in pH, discolouration and almost complete loss of potency after 2.5×10^6 rad. The potency injection of cyanocobalamin (vitamin B_{12}) was reduced from 1,000 mcg/mg to .148 mcg/mg after a dose of 2.5×10^6 rad. (auth)

6100 A/CONF.15/P/277
APPLICATIONS OF RADIOIODINE-132 TO MEASUREMENTS OF DAY TO DAY CHANGES IN HUMAN THYROID FUNCTION. K. E. Halnan and E. Eric Pochin (Univ. of London, Eng.). 22p.

Radioiodine−132 of half-life 2.3 hours has been used for over 2,000 measurements of human thyroid function. It is formed continuously from a Te^{132} suspension and can be distilled from it by a simple and rapid method. A 5 mc source of Te^{132} (half-life 77 hours) initially yields 3 to 5 mc of I^{132} by such distillation and still yields 30 to 50 μc of I^{132} per distillation after 3 weeks' decay. Doses of 6 μc or less are given orally to fasting subjects and the ratio of the radioactivity in neck and thighs is determined by gamma radiation counting two hours later. Apparatus is described which allows these measurements to be made simultaneously, a statistically reliable result being obtainable in 2 to 4 minutes counting on a normal subject after a 6 μc dose. One considerable advantage of using I^{132} in place of I^{131} is the very large reduction in radiation dosage received by the subject. Calculations will be presented for beta and gamma dosage from I^{132} and I^{131} to the gonads and to normal and abnormal thyroid glands in the foetus, neonate, child, pregnant, and non-pregnant adult. Radiation to the normal adult thyroid gland from I^{132} is less

than 1% of that from I^{131}, yet the sensitivity of most counting systems per microcurie is equal or greater for I^{132} than for I^{131}. The value of using I^{132} in tests on children and pregnant women is stressed. A further advantage of I^{132} as compared with I^{131} is that tests may be repeated daily without interference due to thyroid radioactivity from previous tests, I^{132} decaying to 0.1% of its initial activity in 24 hours. Investigations are reported showing the range of results obtained with hyperthyroid, normal, and myxoedematous subjects and the day-to-day variation in thyroid activity of normal subjects. The changes in thyroid function during normal pregnancy and the puerperium are described, but no changes are found in relation to the normal menstrual cycle. (auth)

6101 A/CONF.15/P/278
THE PREPARATION AND USE OF OXYGEN-15 WITH PARTICULAR REFERENCE TO ITS VALUE IN THE STUDY OF PULMONARY MALFUNCTION. N. A. Dyson, P. Hugh-Jones, G. R. Newbery, and J. B. West (Hammersmith Hospital, London). 38p.

Positron-emitting oxygen-15 with a half-life of 2.2 minutes has been prepared by bombarding air with deuterons at various energies between 8 and 14 Mev. The external beam from the cyclotron is used and the oxygen-15 formed by the (d,n) reaction on the nitrogen-14 is available with an activity of up to a curie per liter of air in an adjacent laboratory. Depending upon bombardment conditions, there is up to 5% contamination by carbon-11 (20 minute half-life) and its removal has been studied. The contamination by longer lived isotopes, in particular fluorine-18 (1.9 hours half-life), is very small. There is a slight contamination by ozone. In order to measure the distribution of gas and blood in different parts of the lung, the activated air is much diluted with inactive air, cleaned, monitored and passed into a spirometer from which a patient can take a single breath. The breath is held for a few seconds. The activity in different parts of the lungs is observed, by detecting the annihilation radiation using scintillation counters held external to the chest. The initial counting rate is a measure of the regional distribution of the active gas in specified parts of the lungs, and the fall in the counting rate over a few seconds is chiefly determined by the clearance of the active gas by the regional blood flow. The activity has been observed with a number of single scintillation counters, or with pairs of scintillation counters either in parallel or in coincidence, together with suitable recorders. The advantages and disadvantages of these three techniques for the localization of a small volume of non-functioning lung tissue have been studied. The absorbed dose both in the lungs and in the whole-body has been calculated. Useful information can be obtained with activities small enough for normal subjects to take several breaths of gas without the absorbed dose approaching the maximum permissible level. (auth)

6102 A/CONF.15/P/279
STUDIES OF BODY COMPOSITION IN NORMAL AND PATHOLOGICAL STATES USING ISOTOPE DILUTION TECHNIQUES. E. J. Wayne, M. M. Bluhm, and J. Crooks (Glasgow Univ.). 18p.

The correlation of total exchangeable sodium (Na_e), potassium (K_e), and chloride (Cl_e) with lean-body mass is better than with body weight. In normal subjects it is the same for both males and females. A technique of measuring Na_e, K_e, and Cl_e simultaneously is described. The ratio between sodium space and chloride space in normal subjects is significantly greater than unity, and it is suggested that this is due to the excess of Na_e over Cl_e in bone. In thyrotoxicosis Na_e increases relative to lean-body mass whereas K_e remains unchanged. The relationship between sodium space and chloride space is undisturbed. (auth)

6103 A/CONF.15/P/280
THE METABOLISM OF HEXOESTROL BY RUMINANTS. R. F. Glascock and W. G. Hoekstra (Univ. of Reading, Eng.). 12p.

The absorption, tissue distribution, and excretion of synthetic estrogens used on fattening livestock intended for human consumption can be readily investigated by the use of tritium as a labelling agent. Data are presented which demonstrate the advantages of using compounds of high specific activities when studying the metabolism of such biologically potent substances. The relative tissue distribution of injected estrogens appears to be highly dependent on the amount administered, and it is only through the use of small doses of hexestrol that a selective accumulation of estrogen by reproductive organs has been demonstrated for the first time. By the use of tritium-labelled hormones at physiological dose levels, studies of metabolites and, possibly, mechanisms of hormone action may be greatly facilitated. (auth)

6104 A/CONF.15/P/281
THE PASSAGE OF MARKED IONS INTO TISSUES AND FLUIDS OF THE REPRODUCTIVE TRACT OF PREGNANT RABBITS. J. P. Bennett, J. C. Boursnell, and C. Lutwak-Mann (Cambridge Univ., Eng.). 7p.

Rapid changes were demonstrated in the uptake of labeled ions both in the developing embryo and in the endometrium, mesodermal placental folds, and other closely associated tissues and fluids following the intravenous injection of labeled ions in pregnant rabbits. Phosphorus-32, sulfur-35, sodium-24, iodine-131, and potassium-42 were used as tracers. A number of new techniques were developed to obtain, weigh, and handle the extremely small samples. The influence of exogenous materials on the early development of fetuses is discussed briefly. (C.H.)

6105 A/CONF.15/P/287
THE AVAILABILITY TO PLANTS OF DIVALENT CATIONS IN THE SOIL. R. Scott Russell, R. K. Schofield, and P. Newbould (Argicultural Research Council, Grove, Berks, Eng.). 9p.

Methods for characterizing the equilibrium soil solution are described and are applied to experiments in which soils used in pot culture experiments were labelled with Ca^{45} and Sr^{89}. Six soils showing a wide range of characteristics were used. In all soils the ratio of Sr^{89} to Ca^{45} or to stable calcium in the equilibrium solution was less than the ratio of exchangeable Sr^{89} to Ca^{45} or to stable calcium. The extent to which the ratios differed varied between soils. Three of the soils contained calcium carbonate which somewhat complicates the interpretation. Moreover, when calcium hydroxide was added to these soils varying amounts of calcium carbonate were precipitated. When this occurred after Ca^{45} had been added, some of it was precipitated with Ca^{40}. The ratio of strontium to calcium absorbed from soil by barley and cabbage showed reasonable agreement with that observed when the plants were grown in nutrient solutions similar in composition to the equilibrium soil solution. (auth)

6106 A/CONF.15/P/290

GAMMA RADIATION-INDUCED MITOTIC DELAY AND CHROMOSOME BREAKAGE. G. J. Neary and H. J. Evans (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 13p.

Observations are reported on chromosome aberrations induced by irradiation in the meristematic tissue of the primary root tip of the broad bean, Vicia faba. A method is described for determining mitotic delay in such populations. An investigation was also made on the effect of oxygen tension on the number of primary breaks followed by restitution and reunion. (C.H.)

6107 A/CONF.15/P/291

EFFECT OF RADIATION ON SALT UPTAKE IN PLANTS. D. A. Barber (Agricultural Research Council, Grove, Wantage, Berks, Eng.) and G. J. Neary (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 14p.

In plant nutritional experiments involving phosphate containing P^{32} as a radioactive tracer, there have been indications that the radiation emitted by the tracer may influence the uptake and distribution of salts. The radiation dose to the plant under such circumstances is, however, far from uniform and its estimation is uncertain. Experiments have therefore been carried out using precisely known doses from external sources of radiation. The uptake of Rb by suspensions of Chlorella pyrenoidosa from aerated 0.005 M solutions of RbCl containing tracer amounts of Rb^{86} was investigated at 30°C for periods of 1 hour. The Rb taken up was separated into fractions which exchanged readily with 0.01 M RbCl and which were non-exchangeable under the experimental conditions. This latter fraction would include ions that had undergone active transport. In no experiment was there any significant effect of radiation on the amount of the readily exchangeable ion fraction. During the period of Rb uptake 240-kv, x rays, and Co^{60} γ rays significantly decreased the amount of non-exchangeable ion taken up. Over the range of 50 to 300 r there was an increased effect with increasing dose with little further increase in effect over the range of 300 to 1000 r. It appeared that the effect was proportionally greater when the natural rate of salt uptake was small. When x rays were delivered immediately prior to the period of Rb uptake there was a significant increase in the amount of non-exchangeable salt taken up as compared with the unirradiated controls. This effect appeared to be dose dependent and not influenced by dose-rate. The stimulatory effect of x rays delivered prior to Rb uptake was shown to exhibit an oxygen effect stimulation by a given dose being much reduced by irradiation under anaerobic conditions. In common with many physiological effects of radiation, the stimulatory effect of x rays appears to be connected with the oxidation of sulfhydryl groups since pretreatment with sulfhydryl inhibitors had a similar effect and the presence of cysteine prevented the stimulation caused by both x rays and sulfhydryl inhibitors. (auth)

6108 A/CONF.15/P/292

AGEING EFFECTS OF IONIZING RADIATIONS. Patricia Lindop and J. Rotblat (Saint Bartholomew's Hospital Medical Coll., London). 22p.

A systematic study is being made of the long term effects of a single exposure to x rays in mice, with the aim of finding evidence for an acceleration of aging, and to test the theories for this process. About 3,500 albino mice were given a single dose of 15 Mev x rays at the age of 30 days; 14 dose groups were used ranging from 50 to 850 rads. All irradiated mice were kept under exactly the same conditions as 1,200 control mice, who had undergone sham irradiation at the same age. The life history of each mouse is being followed until death, when a detailed post mortem examination is done to try to find the cause of death. A shortening of life span has been observed in the high dose groups, but is not yet evident in the low dose groups. A number of cataracts, lukemias, thymic, and other tumors have been observed and the incidence rate is being studied as a function of time and dose. Certain physiological function tests, which may vary with age, are carried out at regular intervals on random samples of mice from the irradiated and control groups; one of these is based on the measurement of voluntary body movement. Body weights and hematological changes are recorded, and fertility is being studied as a function of dose-time after exposure and age. Histological material is collected at post mortem and from tested animals. In order to determine the radiobiological efficiency for the 15 Mev x rays in relation to the 250 kv x rays, the LD_{50} at 30 days was measured for the same strain of mice using 15 Mev, 1 Mev, and 250 kv x rays. In another experiment, in which about 5,000 mice are used, the sensitivity to radiation as expressed by the LD_{50} at 30 days and by life shortening, is being studied as a function of age, from birth up to the mean life span. The results obtained so far, at ages from 3 to 18 weeks, show a steady increase of the LD_{50} from 710 to 925 rads. This finding is contrary to the predictions of Blair's theory. In a third experiment, the effect of parent irradiation on subsequent generations is being studied up to the third generation. Litters are produced from either irradiated or non-irradiated fathers with non-irradiated mothers. Some of their male progeny are then irradiated, and again litters are produced from irradiated and control fathers. In the third generation some mice are again exposed to radiation and some are kept as controls. In all these experiments emphasis is laid on accurate dosimetry, and identical treatment and maintenance of irradiated and control mice. (auth)

6109 A/CONF.15/P/293

THE INFLUENCE OF OXYGEN AND PEROXIDES ON THE RESPONSE OF MAMMALIAN CELLS AND TISSUES TO IONISING RADIATIONS. L. H. Gray, H. B. Chase, E. E. Deschner, J. W. Hunt, and O. C. A. Scott (Mount Vernon Hospital, Northwood, Middx., Eng.). 16p.

At the cellular level the response of ascites tumor cells to x radiation has been investigated as a function of the concentration in the surrounding medium of oxygen and of certain peroxides. Low concentrations of peroxide raise the sensitivity of anoxic cells, probably by acting as an intracellular source of oxygen. The observed relation between radiosensitivity and concentration of molecular oxygen in the medium is substantially the same for ascites tumor cells as that reported by Howard-Flanders and Alper for microörganisms. Temperature dependence of anaerobic and aerobic sensitivity is also reported. Some remarks are made on mechanisms which may be involved in the oxygen-dependent component of radiosensitivity. In vivo observations have been made of the radiosensitivity of ascites tumor cells, with simultaneous measurements of the oxygen tension in a bubble located in the peritoneal cavity. These observations give information as

to the identity of in vitro and in vivo sensitivity. From them may also be derived information concerning the distribution of oxygen tension within the peritoneal cavity of a tumor-bearing animal when breathing air and gas mixtures in which the partial pressure of oxygen is a variable. Average sensitivity may be depressed or raised by control of this variable. Observations have been made of the greying of hair in mice which reflects damage to the pigment cells of the hair follicle. Growing and resting follicles are examined separately; observations have been made on animals breathing air and oxygen. Application of a vascular clamp reveals the influence of oxygen which enters through the skin upon the radiosensitivity of the pigment cells. The in vivo observations are related to the influence of oxygen at the cellular level as revealed by the studies with suspensions of ascites tumor cells. (auth)

6110 A/CONF.15/P/321
ETUDE DE L'ERYTHROPOÏESE CHEZ LE CHIEN NEPHRECTOMISE. (A Study on Erythropoiesis in the Nephrectomized Dog). J. P. Naets (Univ. of Brussels). 27p.

To clarify the etiology of the anemia caused by chronic renal insufficiency, a study of erythropoiesis was made in the nephrectomized dog. The operation was carried out in two stages, with the second nephrectomy 15 to 30 days after the first, the animals being kept alive by peritoneal dialysis. The bone marrow was taken from the iliac crest. A rapid fall was noted in the erythroblast count. From the third day after the second nephrectomy, no erythroblasts were found. These morphological findings were corroborated by a study of the rate of uptake of Fe^{59} by the erythrocytes. The plasma clearance of iron was slowed down in the nephrectomized dogs with T/2 = 279 min, as opposed to 89 min in the controls. The plasma iron turnover is also reduced in the nephrectomized subjects. The fixation by erythrocytes is practically stopped in the animals whose kidneys were removed. These results showed that bilateral nephrectomy inhibits erythropoiesis. However, it could not be determined whether there is an inhibitory phenomenon which is secondary to a retention of the toxic products normally secreted by the kidneys of whether the absence of any renal erythropoietic factor is involved. (J.S.R.)

6111 A/CONF.15/P/323
PREPARATION OF TRITIUM-LABELED THYMIDINE AND ITS USE FOR THE STUDY, BY THE RADIOAUTOGRAPHIC METHOD, OF THE SYNTHESIS OF DEOXYRIBONUCLEIC ACID IN CELLS BEING CULTURED. W. G. Verly, H. Firket, and G. Hunebelle (Univ. of Liège). 10p.

The biosynthesis of desoxyribonucleic acid was studied in chicken fibroblasts. Autoradiograms were made of tissues following culture in a medium containing tritium-labeled thymidine. Incorporation of labeled thymidine in the nucleus precedes mitosis by about 7 hours and coincides statistically with the increase in quantity of desoxyribonucleic acid in the nucleus as measured by Feulgen's test. At the time of division, the newly formed desoxyribonucleic acid is distributed equally between the two sets of chromosomes that are to form the nuclei of the daughter cells. After three days of contact with tritium-labeled thymidine, there remain some nuclei that are not labeled. These nuclei do not seem to participate in the mitotic cycles; the technique employed shows no synthesis of desoxyribonucleic acid. There is no turnover of such nucleic acid, nor exchange of its thymidine fraction. (C.H.)

6112 A/CONF.15/P/332
SUR LA FIXATION DU RADIOPHOSPHORE MINERAL (^{32}P) PAR DES CELLULES BACTERIENNES EN CROISSANCE. (Fixation of Mineral Radiophosphorus (P^{32}) by Bacterial Cells in Growth.) A. Guelin and P. Lépine (Institut Pasteur, Paris). 8p.

Radiophosphorus is used in the study of the metabolic processes in bacteria and bacteriophagocytes. However, the phosphorus distribution and the conditions under which assimilation occurs are not well defined. An investigation was made with Shigella paradysenteriae Y6R on this problem. The results showed that P^{32} does not augment the multiplication of either the bacteria or the bacteriophage C16 associated with it. The phosphorus is retained in larger quantities by bacteria which are multiplying. The larger part of P^{32} retained appears to be attributable to adsorption on the bacterial surface rather than to assimilation. (J.S.R.)

6113 A/CONF.15/P/469
ON THE REACTIONS OF THE LANGERHANS ISLETS AND THYROID GLAND FOLLOWING TOTAL BODY X-IRRADIATION. N. Allegretti (Inst. "Ruder Bošković," Zagreb). 13p.

Two different and dissimilar reactions in functional state and physiological efficiency were observed in islets of Langerhans in the pancreas and in the thyroid gland in rats and guinea pigs following exposure to whole-body irradiation. Relationship of endocrine gland function to carbohydrate metabolism and response to stress are discussed. (C.H.)

6114 A/CONF.15/P/470
THE EFFECTS OF IRRADIATION ON THE BRANCHING OF CORN STALKS. Miloje R. Sarić (Inst. for Plant Improvement and Production, Zemun, Polje, Yugoslavia). 9p.

Irradiation of corn seeds with doses above 10,000 r x radiation resulted in plants characterized by abnormal branching. Results are described and illustrated with photographs. (C.H.)

6115 A/CONF.15/P/472
STUDYING THE EFFECT OF IRRADIATION IN DEPENDENCE OF BIOLOGICAL PROPERTIES OF THE SEED IRRADIATED. Miloje R. Sarić (Inst. for the Improvement and Production of Plants, Zemun Polje, Yugoslavia). 44p.

Experiments on the seeds of wheat, barley, oats, and rye showed that the ontogenetic younger seeds were more susceptible to irradiation than the older ones, with a smaller percentage of germination and a lower number of primary roots. The artificial tetraploid form of Petkus rye was more resistant to irradiation than the diploid one, which could be ascribed only to the greater number of chromosomes. In natural polyploids of wheat the effect of irradiation depends more on the characteristics of the kind of variety in question than on the chromosome number. Finally, the single or double hybrid corns are more resistant to irradiation than any inbred lines. (auth)

6116 A/CONF.15/P/479
FUNCTIONAL AND MORPHOLOGICAL CHANGES OF THE THYROID GLAND IN THE RAT FOLLOWING THE ADMINISTRATION OF VARIOUS DOSES OF RADIOAC-

TIVE IODINE I^{131}. M. Jovanović, V. Pantić, et al. (Univ. of Belgrade). 16p.

The rate of the basal metabolism in rats was measured for 80 days after the administration of radioiodine in doses of 20, 50, 100, and 300 μc in order to establish the degree of the injuries in thyroid gland and the intervals after which these injuries took place. The results obtained by examination of the oxygen consumption were compared with the results obtained by the examination of the radioiodine fixation and with the morphological structure of the thyroid gland. Data indicate that the oxygen consumption rate is not a sufficiently sensitive indicator for establishing the lighter morphological and functional injuries in the thyroid gland. (C.H.)

6117 A/CONF.15/P/481

ON THE METABOLISM OF ^{14}C LABELLED SEROTONIN IN VIVO. D. Keglević-Brovet, Z. Supek, et al. (Inst. Ruder Bošković, Zagreb). 10p.

The metabolism of serotonin-C^{14}, labeled in the alpha position of the amino group, was studied in rats. In each of four experiments the serotonin was injected subcutaneously, and the animal was placed in a glass metabolism cage for quantitative collection of expired CO_2, urine, and feces. A blood sample was taken after 24 hours. The results showed that only a small fraction of the injected radioactivity was expired. The most rapid excretion of labeled CO_2 occurred 8 to 14 hours after serotonin administration. The preponderant fraction of the radioactivity was eliminated in the urine. The excretion was quite rapid, with 40% of the radioactivity being eliminated within the first twelve hours. Less than 2% of the original dose was eliminated through the feces. The distribution of the radioactivity in the organs and tissues was studied, and no activity was found in the brain. Small amounts were found in all other organs, with the spleen having the highest specific activity. Chromatographic studies of the urine showed that about 50% of the urine activity is caused by 5-hydroxyindoleacetic acid. (J.S.R.)

6118 A/CONF.15/P/487

A CONTRIBUTION TO THE ROLE OF HEMATOPOIETIN DURING THE RADIATION SICKNESS. M. Dragić and M. Radotić (Inst. of Nuclear Sciences "Boris Kidrič," Belgrade). 6p.

Ionizing radiations produce a hypoplastic reduction of the bone marrow by depressing its hematopoietic functions. Normally, a humoral factor contained in the plasma of anemized animals, hematopoietin, stimulates the proliferative processes of the erythroid elements in the bone marrow. The effect of hematopoietin on the hematopoietic recovery and on the lethality of irradiated rats, previously injected with anemic and normal rabbit plasma, was studied. The rats received 1 or 2 ml of plasma 7 to 14 days before irradiation. Preliminary experiments show a 30% survival after a dose of 850 r. No difference was observed between the rats treated with anemic plasma. The role of the latter has not been clarified. (auth)

6119 A/CONF.15/P/489

THE PROTECTIVE EFFECT OF ACTH IN THE INFANTILE RATS AGAINST X-IRRADIATION. S. D. Sladić, D. V. Radivojević, and D. M. Pavić (Inst. of Nuclear Sciences "Boris Kidrič," Belgrade). 16p.

Newborn rats up to 17 days of age exposed to sublethal doses of x rays were treated directly after irradiation with adrenocorticotropic hormone from the anterior pituitary. Control animals of the same age, which were not treated with ACTH, showed different degrees of protection achieved by treatment, depending upon the age of the animal. Untreated rats up to 10 days of age showed a mortality rate of 83%, whereas for the treated animals the mortality was reduced to 44%. The mortality in both untreated and treated rats between 15 and 17 days of age was 23%, which shows that injected ACTH as such had no protective influence on the treated group. The protective effect of ACTH, in all probability, is mediated through the stress reaction which has been universally accepted as a defense mechanism. Studies have shown that rats up to 10 days of age fail to develop a stress reaction after irradiation. They have also shown that rats of this age are very sensitive to irradiation and that injected ACTH considerably reduces the mortality rate among them. The rats between 15 and 17 days of age have a fully developed mechanism for the stress reaction to irradiation, and injected ACTH did not enhance their resistance to this particular stressor. (auth)

6120 A/CONF.15/P/490

RECOVERY FROM RADIATION INJURY IN RATS FOLLOWING ADMINISTRATION OF NUCLEIC ACIDS. B. Panjevac, G. Ristić, and D. Kanazir (Inst. of Nuclear Sciences "Boris Kidric," Belgrade). 24p.

The experiments reported were undertaken in order to find out whether the highly polymerized isologous, homologous, and heterologous nucleic acids might have a protective effect on irradiated rats. All the rats, separated in groups, received a single whole-body exposure of 700 and 800 r. The radiation exposure was followed by injection of highly polymerized desoxyribonucleic acid and rat bone-marrow nuclei. The nucleic acids and the bone-marrow were prepared from young rats. The protective action of nucleic acids and bone-marrow suspensions was estimated on the basis of 30-days survival, increase of nucleic acid content of the spleen, and increase of body weight. The experimental data showed that the 30-day survival observed after treatment with nucleic acids is dependent upon the dose applied and the amount and nature of the injected protective material. The recovery of irradiated rats treated with nucleic acids was evidenced by the cessation of body weight loss and by an increase of the nucleic acids content of the spleen. Under conditions in which x-irradiated rats received mixtures of DNA + RNA, the results were similar to those observed on rats to which bone-marrow nuclei had been injected. (C.H.)

6121 A/CONF.15/P/494

NEW SERUM HUMORAL FACTOR DERIVED FROM YOUNG IRRADIATED RATS INFLUENCING PERIPHERAL RETICULOCYTE COUNT. S. Hajduković and Lj. Stošić (Inst. of Nuclear Sciences "Boris Kidric," Belgrade). 7p.

Whole-body x irradiation at doses of 700 r applied to new-born and young rats produces an increase in the number of reticulocytes in peripheral blood, which was manifested 5 to 30 min after irradiation. This observed increase, under the experimental conditions used, was of the order of 150 to 250%. Physiological properties of this serum humoral factor, not known in adult animals, and its relationship to the age and endocrine influences were studied and the results discussed. (auth)

6122 A/CONF.15/P/547

RADIOACTIVITY IN MARINE ORGANISMS. A. H. W. Aten, Jr. (Inst. voor Kernphysisch Onderzoek, Amsterdam). 17p.

When radioactive waste is let out into the sea or the ocean, essentially from a single source, a characteristic time can be defined, which indicates how rapidly the daily discharge rises. For this purpose the time during which this discharge is doubled may be chosen. The uptake of a radioactive nuclide by a marine organism can be treated in a simple way, in case the time required for renewal of the element concerned in the organism is either long or short compared to the characteristic time mentioned above. A second factor which enters into consideration is the source from which the organism replenishes its content of the element, either the ions or molecules which have been discharged as such or other organisms which in their turn have a specific rate of renewal of their own. If various assumptions are made concerning the variation of the rate of waste disposal, the activity of a certain nuclide in different types of organisms can be calculated as a function of time. The shape of the activity uptake curve can be recognized if the activity of the organisms is analyzed at different times, and this information may be used to predict activities at later periods. These predictions should be valuable when decisions must be reached concerning the amount of activity that can be discharged with safety. (auth)

6123 A/CONF.15/P/555

TRANSPLANTATION OF HEMATOPOIETIC CELLS IN IRRADIATED ANIMALS: A STUDY OF HOST-GRAFT INTERACTION. D. W. van Bekkum, O. Vos, et al. (National Defence Research Council T.N.O. and Rijswijk-ZH, The Netherlands). 7p.

The transplantation of foreign hematopoietic cells after total-body irradiation has been the subject of a great number of investigations. It is now known that only under certain specific conditions permanent takes of foreign bone marrow can be obtained. Among the factors influencing the result are the dose of irradiation, the number of living bone marrow cells injected, and the immuno-genetic relation between the host and the donor animal. So far homologous and heterologous bone marrow transplantation has been proved in a limited number of host-donor combinations. After the successful grafting of the foreign bone marrow, which offers protection to the irradiated animals during the acute period of the radiation disease, a severe complication has been observed. The nature of this foreign bone marrow disease is at present the subject of intense studies. Results are reported which indicate that the disease may be caused by an immunological reaction of the grafted tissues against the host animals, the pathological effects of this reaction being influenced by the preceding irradiation. Investigations of the nature of graft anti-host reaction in unirradiated animals support this hypothesis. Several experimental applications of foreign bone marrow transplantation are reported. (auth)

6124 A/CONF.15/P/556

THE ROLE OF TISSUE HYPOXIA IN CHEMICAL PROTECTION. C. van der Meer, D. W. van Bekkum, and J. A. Cohen (National Defence Research Council T.N.O., Rijswijk-ZH, The Netherlands). 6p.

Chemical substances which protect mice against the lethal effects of total-body irradiation may be divided into several groups according to different mechanisms of the protective action. Several compounds, all of which belong to the biological amines, were found to be completely devoid of protective activity towards isolated cells, while being excellent protectors for mice. Consequently, it has been postulated that these compounds protect the intact animal by way of their pharmacological effects, e.g., on the vascular system or on the central nervous system. Such effects may result in localized or general hypoxia. Protective dosages of histamine and epinephrine were found to induce hypoxia of the spleen. The protection obtained under these conditions has been compared with the protective effects of reduced oxygen tension during irradiation. From the results obtained the conclusion was reached that the protective action of these amines is largely, if not wholly, due to the production of hypoxia in the hematopoietic tissues. It remains therefore difficult to maintain the hypothesis that these protectors act by combining with radicals produced by the radiation in the living cells. This conclusion is further supported by the results obtained with combinations of a number of protective substances and their pharmacological antagonists. Investigations on a number of protective sulfhydryl compounds are also reported. Evidence is presented which indicates that a different mechanism of action may be involved. (auth)

6125 A/CONF.15/P/557

DETERMINATION OF THE TURNOVER OF BLOOD COMPONENTS USING LABELLED DIISOPROPYLPHOSPHOROFLUORIDATE. J. A. Cohen (National Defence Research Council T.N.O., Rijswijk-ZH, The Netherlands) and L. M. van Putten (National Health Research Council T.N.O., Rijswijk-ZH, The Netherlands). 6p.

Diisopropylphosphorofluoridate labeled with phosphorus-32 (DFP^{32}) was found to combine irreversibly with components from human blood leading to labeling of those components by phosphorus-32. This reaction was first used for the determination of the life span of human red cells and the turnover of human serum. Normal values of 110 to 130 days for the mean red cell life span were found. The labeled component of the human serum proved to be pseudo-cholinesterase. This serum component has a half life of 12 to 14 days. The method proved also of value for the labeling of human blood platelets. A linear relationship between time and platelet-bound radioactivity was found indicating a measurable life span of these elements under normal circumstances. The slope of the curves obtained suggested that the life span amounts to about 8 to 9 days. Applications of the method have been extended to include its use for the determination of the life span of erythrocytes of small laboratory animals. It was found that the disappearance of the red cells is linear with time and that the red cells in both rats and mice have a true life span without measurable random destruction. The life span of the erythrocytes was found to be 60.0 ± 3.2 days in the rat and 40.7 ± 8.9 days in the mouse. Especially in the mouse the determination of the red cell life span with DFP^{32} is a simple procedure. The results obtained with the DFP method are discussed, and its merits evaluated against those of other methods. (auth)

6126 A/CONF.15/P/558

OBSERVATIONS ON THE BEHAVIOUR OF PHOSPHATE COMPOUNDS IN CHLORELLA AT THE TRANSITION FROM DARK TO LIGHT. W. Lindeman (Agricultural Univ., Wageningen, The Netherlands). 17p.

Trichloroacetic acid extracts of Chlorella cells, which had been labeled with P^{32} for 24 hours, were analyzed by paper chromatography. The decrease in

orthophosphate and the increase in nucleotides, observed at the transition from dark to light, were considered as indications of light phosphorylation. A rapid decrease in phosphoglyceric acid, interpreted as the reduction of this compound, occurred simultaneously. Since this reduction probably consumed energy-rich phosphate bonds, releasing free orthophosphate, this consumption was considered in estimating the rate of light phosphorylation and the P/O ratio. (auth)

6127 A/CONF.15/P/562
THE EFFECTS OF RADIATION IN PLANT NUTRITION EXPERIMENTS WITH RADIOPHOSPHORUS. Kjell Steenberg (Agricultural Coll. of Norway, Vollebekk). 30p.

In all tracer experiments with living plants using radioactive isotopes, it is essential for the validity of the experiments that the processes to be studied are not affected by the radiation. Results are reported from experiments on uptake of phosphorus in cereals from P^{32}-labelled phosphates of different specific activities. The plants are examined for the radiation effects of importance in the study of fertilizer problems. The plants were grown in pots with sandy soil in a glasshouse. The labeled phosphate and the nutrient solutions supplied were thoroughly mixed into the soil. Two fertilizer levels of phosphate were used equivalent to about 40 and 80 lbs P_2O_5 per acre. The plants were mostly oats, but also some pots with barley were used. Twenty different dose levels were applied, ranging from zero to 200 mc/g P for oats and from zero to 100 mc/g P for barley. At the highest doses the plants displayed severe injuries. Data are tabulated on dry weight, ash, and total and fertilizer derived phosphorus. Straw and grain were analyzed separately. Visual symptoms of radiation damage are described and discussed in the light of earlier data on P^{32} radiation effects in plants. (C.H.)

6128 A/CONF.15/P/564
AN INSTRUMENT PERMITTING A RAPID AND HOMOGENEOUS ADMINISTRATION OF RADIOACTIVE FLUIDS IN THE TREATMENT OF MALIGNANT TUMORS. Kåre Myhre (Ullevål Sykehus, Oslo). 4p.

The success of treating malignant tumors with intratumoral injection of radioactive fluids is dependent upon the degree of an adequate and uniform radiation. The main obstacle has been the uniform distribution of the radioactive fluid, requiring a lot of time and thus exposing the operator to an undesirable amount of radiation. A pistol-type applicator is described which is fitted with a syringe and an adjustment for depth determinations. The instrument offers the advantages of even distribution in the pathway of the needle, an adequate amount of fluid not exceeding the capacity of the canal formed by the needle, and a minimum amount of radiation to the operator. (C.H.)

6129 A/CONF.15/P/568
IMPROVED STORAGE QUALITY OF POTATOES, VEGETABLES AND FRUITS EXPOSED TO GAMMA RADIATION. K. Mikaelsen, H. K. Brenna, and R. Landfall (Agricultural Coll. of Norway, Vollebekk). 15p.

Results are presented from an investigation of the influence of irradiation on the storage quality of vegetables and fruits. Irradiation with 5000 r gamma radiation and storage at low temperatures prevented sprouting completely for one year in three varieties of potatoes. Reduced respiration intensity was found in all series of irradiated potatoes. Results are compared with those obtained by treatment with Fusarex, a growth inhibitor. Sprouting and growth were satisfactorily prevented in carrots and other root crops by exposure to 5000 to 15000 r gamma radiation. The storage life of bananas and apples was improved if they were irradiated in a pre-ripened stage. (C.H.)

6130 A/CONF.15/P/579
THE PROPERTIES OF A NEW CESIUM-137 PLESIOTHERAPY UNIT SHIELDED WITH TUNGSTEN ALLOY AND URANIUM. Johan Baarli (Norwegian Radium Hospital, Oslo). 17p.

A brief description is given of a plesiotherapy unit using cesium-137. This unit contains a doughnut-shaped 50-curie Cs^{137} source, movable from a shielded to a treatment position. The nozzle arrangement is furnished with two separate treatment ports and is made of uranium which makes it possible to operate the unit at a source-skin distance of 4 cm, with well defined radiation fields. Detailed studies of the depth and isodose distributions using various fields are reported. Special attention is paid to the filter and lining materials in order to reduce the skin dose caused by secondary electrons. The unit was found suitable for treatment of cancer metastases to the glands of the superclavicular region with reduced dose to the lungs beneath. The unit can be operated at a source-skin-distance between 4 and 10 cm, with dose rates varying from 100 to 17 r/min at these distances, respectively. (auth)

6131 A/CONF.15/P/588
THE PREDICTION OF MUTATION PATTERNS AFTER EXPOSURE TO CHRONIC IRRADIATION. Per Oftedal (Norsk Hydro's Inst. for Cancer Research, Oslo). 17p.

When Drosophila males are exposed to radiation from internally deposited P^{32}, a mutation pattern with time may be observed. This pattern is different from that found after acute exposure to x rays. This difference might be caused by the difference in radiation intensity, or be due to transmutation effects of P^{32} incorporated into the genetic material. The incorporation curve of P^{32} into a non-hydrolyzable fraction of the sperm has been found to be closely correlated to the mutation curve. In an attempt to resolve this question a method for estimating the genetic effect to be expected was developed. (auth)

6132 A/CONF.15/P/972
THE EFFECT OF HIGH-ENERGY RADIATION (GAMMA-RADIATION AND REACTOR NEUTRONS) ON WOOL KERATIN AND POLYAMIDE AND POLYESTER FIBRES. E. R. Fritze, H. Pfannmüller, et al. (Deutsches Wollforschungsinst. an der Technischen Hochschule, Aachen). 15p.

Results are reported from a series of chemical and physical investigations on irradiated wool. Natural fiber wool was found to be more stable to ionizing radiation than polyester and polyacrylonitrile fibers. High-energy radiation induced degradation in the amino acids present in untreated wool. Reaction mechanisms are reviewed, and procedures are discussed for the stabilization and chemical protection of fiber proteins, such as wool keratin, against radiation degradation. (C.H.)

6133 A/CONF.15/P/973
THE HEIDELBERG TECHNIQUES OF CONTACT IRRADIATION WITH Co^{60}: EXPERIENCE WITH 1,500 PATIENTS TREATED. I. Becker and K. E. Scheer (Germany). 11p.

Three techniques of contact irradiation employing cobalt-60 are described. These include beads of metallic

gold containing a little ring of activated cobalt for use in intracavitary irradiation, individually shaped molds of metallic gold containing a core of cobalt-60, and rubber balloons filled with a suspension of an inactive jelly containing 2 mm pellets containing cobalt-60. Clinical results are summarized for a series of 1,500 patients treated during a seven-year period. Good results are reported when the applicators were used for the treatment of carcinoma of the urinary bladder, brain tumors, rectum carcinoma, carcinoma of the maxillary antrum, carcinoma of the female genital tract, and in some special cases of skin tumor. (C.H.)

6134 A/CONF.15/P/974
SPECIAL APPLICATIONS OF CAESIUM 137 IN RADIOTHERAPY OF SHORT DISTANCE. Friedrich Gauwerky (Germany). 4p.

Applications of cesium-137 as a gamma source in cancer therapy are discussed. As all cesium salts are highly hygroscopic, the isotope must be used in closed tubes. Special applicators of plastic and tungsten proved practical for radiotherapy of limited areas at short distance. Good results are reported in the treatment of 72 cases of carcinoma. (C.H.)

6135 A/CONF.15/P/976
THE METABOLISM OF ORGANOPHOSPHATES IN CARDIAC TISSUE AS STUDIED WITH RADIOPHOSPHORUS AND PAPER CHROMATOGRAPHY.
A. Fleckenstein and Johanna Janke (Univ. of Freiburg, Ger.). 18p.

The metabolism of organophosphates in cardiac tissues was studied using phosphorus-32-labeled orthophosphate. The tracer was administered either to hearts in situ by intravenous injection or by addition to the Ringer bath containing isolated auricles. Cardiac tissue was found to transfer measurable amounts of radiophosphorus from the extracellular space into the intracellular organic phosphorus fractions within a few minutes. To determine the pathway of phosphorus-32 incorporation, heart tissue was frozen in liquid nitrogen at various time intervals. Extracts of frozen muscle powder were analyzed by paper chromatography for activities taken up by the various phosphorus fractions, and the specific activities of phosphorus–molybdate solutions were counted in a fluid counting tube. The data allow an easy calculation of the individual specific activities of the various phosphate groups. Data are tabulated and presented graphically. Results indicate that radiophosphorus and paper chromatography offer a useful tool for studies of cardiac metabolism. (C.H.)

6136 A/CONF.15/P/979
EXPERIMENTS ON TRITIUM-LABELED INSULIN.
C. v. Holt, I. Nolte, and L. v. Holt (Univ. of Hamburg). 17p.

It is possible to label the proteohormone insulin in high specific activity by means of the Wilzbach procedure with tritium. With this procedure the biological activity is preserved. Physicochemical and radiochemical properties of tritium–insulin are described. Estimation of the specific activity of amino acids chromatographically separated on columns gives insight into the exchangeability of hydrogen and tritium of the different amino acids bound in the protein. Results from animal experiments to test the tritium–insulin as a biological tracer are compared with those using iodine-131-labeled insulin. (C.H.)

6137 A/CONF.15/P/980
THE UPTAKE OF ZINC AND STRONTIUM IN VITIS VINIFERA. O. Siegel and W. Goerke (Pfälz. Landw. Untersuchungsund Forschungsanstalt Speyer/Rhein). 11p.

Data are reported from a study of zinc-65 uptake by grape vines. A method is described for measuring the rate of intake of trace amounts of chemicals by plants. It is suggested that the method may also be used for measuring the rate of deposition of fall-out on plant surfaces. (C.H.)

6138 A/CONF.15/P/989
USE OF ^{32}P FOR INVESTIGATIONS IN THE SYSTEM SOIL–SOIL SOLUTION–PLANT. F. Scheffer and B. Ulrich (Univ. of Göttingen, Ger.). 8p.

The use of P^{32} in pot experiments allows the calculation of the amount of nutrient in the plant, coming from the fertilizer, the percentage of the fertilizer taken up by the plant, the isotopic exchangeable soil phosphorus, and the percentage of water insoluble fertilizer which has reacted with the soil solution. Examples are discussed. The validity of isotope dilution equation in pot experiments is discussed, partly in connection with reversible phosphorus exchange between plant and soil and nutrient solution. Kinetic studies are described on determination of isotopic exchangeable soil phosphorus in three or more reactions, which are characterized by the reaction half-time and the amount of phosphorus involved. The processes responsible for the availability of nutrients in soil are discussed briefly. (auth)

6139 A/CONF.15/P/990
THE INFLUENCE OF POTASSIUM AND SODIUM ON THE METABOLISM OF METHIONINE IN YEASTS (INVESTIGATED WITH S^{35}). F. Alten and O. Werk (Landwirtschaftliche Forschungsanstalt Büntehof, Hanover). 5p.

The influence of potassium and sodium on the metabolism of methionine in yeast was studied. Sulfur-35 was added to suspensions of potassium-exhausted yeasts. The effects of sodium and potassium on the uptake of sulfur and the formation of methionine were measured. Data are tabulated and discussed. (C.H.)

6140 A/CONF.15/P/991
RADIOSENSITIVITY OF VARIOUS TISSUES AND ITS MODIFICATION BY BIOLOGICAL RADIOPROTECTIVE SUBSTANCES. V. Hagen and H. Ernst (Heiligenberg-Inst., Baden, Ger.). 11p.

Results are reported from examinations of 1500 rats in an effort to obtain information on dose effects following exposure to doses of 400 to 1000 r x radiation. The inhibition of desoxyribonucleic acid synthesis and the activation of cathepsin activity in the spleen, thymus, and liver were measured. The effects of pretreatment with cysteamine were studied, and the liver and thymus were examined for atrophy. Dose effects curves for protected and unprotected animals are presented. Data are discussed. (C.H.)

6141 A/CONF.15/P/993
EFFECTS OF PROTECTIVE AGENTS APPLIED AFTER IRRADIATION. Hans A. Künkel and Gerhard Schubert (Universitäts-Frauenklinik, Hamburg-Eppendorf). 15p.

Cysteine was found to exert a protective effect against radiation injuries when administered after irradiation to hibernating mammals, resting seeds of plants, and cooled single sperm cells. The protection afforded by a low metabolic state against radiation injuries is discussed. (C.H.)

6142 A/CONF.15/P/994
EARLY BIOCHEMICAL REACTIONS FOLLOWING

X-IRRADIATION. Heinrich Maass and Gerhard Schubert (Univ.-Frauenklinik, Hamburg-Eppendorf). 18p.

X-ray-induced changes in biochemical reactions occurring early after irradiation were investigated. Experiments showed that the activity of 12 enzymes of carbohydrate metabolism measured in irradiated liver homogenates is not altered after exposure to 4,000 and 20,000 r x rays. After irradiation in purified solution, however, the enzymes showed high radiosensitivity. Further experiments were made on carbohydrate metabolism, especially of tumor cells which were irradiated in vitro. X irradiation with doses of more than 5,000 r resulted in inhibition of the glycolysis without altering the respiration. Similar effects were observed on carbohydrate metabolism of irradiated slices of spleen, brain, and thymus. The glycolysis of the rat liver remained uninfluenced. By determinations of some metabolite concentrations, the mechanism of the x-ray-induced inhibition of the glycolysis was elucidated. According to these experiments the point of attack of the x-ray effect lies within the glycolysis chain on the step of the dehydrogenation of triosephosphate. The activity of triosephosphate dehydrogenase is not influenced, but it could be demonstrated that the DPN concentration decreases tremendously and will then be limiting for the triosephosphate dehydrogenation. As expected, the inhibition of glycolysis is followed by a decrease of ATP. Consequently, it could be shown that there is an inhibition of C^{14}-alanine uptake into the protein of the irradiated tumor cells parallel to the low ATP level. Results indicate that protein synthesis itself is not directly influenced by irradiation. The analysis of free amino acids showed no essential change concerning their concentrations. A clear reduction of the C^{14} activity of the most amino acids was observed with the exception of alanine. (auth)

6143 A/CONF.15/P/995
MICROAUTORADIOGRAPHICAL TESTS WITH LABELLED RADIATION-PROTECTIVE SUBSTANCES. R. Koch and F. Passalacqua (Univ. of Freiburg i B. and Heiligenberg-Inst., Baden, Ger.). 10p.

Results are reported from studies on the mechanism of the protective action of sulphydryl compounds against radiation injuries. The possibility of the protective action being mediated through topographical or functional action is considered. The distributions of cysteine-sulfur-35 and thiourea-sulfur-35 were determined by micro-autoradiographic techniques following injection in mice. Data are tabulated. Activity was demonstrated in the nuclei of cells from liver, spleen, and kidney, but not in pancreas and thymus. (C.H.)

6144 A/CONF.15/P/1006
THE INFLUENCE OF GLUCOSE ABSORPTION ON THE ^{32}P-TURNOVER OF ORGANOPHOSPHATES IN THE INTESTINAL MUCOSA. E. Gerlach (Univ. of Freiburg i B.). 12p.

Results are reported from a study employing phosphorus-32 and paper chromatography to trace the metabolism of organophosphates in the intestinal mucosa of rats. The intestinal absorption of glucose was found to stimulate phosphorus metabolism not only in the intestinal mucosa but also in skeletal muscle, liver, and kidneys. Data are tabulated and discussed. (C.H.)

6145 A/CONF.15/P/1007
DYSREGULATORIC AND CYTOSTATIC FACTORS IN THE INITIAL PHASE OF BONE MARROW DESTRUCTION BY IONIZING RADIATION. THEIR DIFFERENTIAL ROLE FOR THE POSSIBILITIES OF THERAPY. R. Stodtmeister, St. Sandkühler, and M. Th. Fliedner (Univ. of Heidelberg, Ger.). 11p.

The pathogenesis of bone marrow damage was followed histologically in rats exposed to whole-body doses of 600 to 800 rep fast electrons from a 15-Mev betatron. This dose is about LD 50/30. Maximum destruction in surviving animals was reached about 72 hours after exposure. After this time regeneration began to take place. Results are described. 8 figures. (C.H.)

6146 A/CONF.15/P/1050
RADIO-VITAMIN B_{12}-ABSORPTION-STUDIES; A CONTRIBUTION TO A NEW CONCEPTION OF THE INTRINSIC FACTOR-MECHANISM OF ACTION IN SWINE. H. C. Heinrich, H. Hill, et al. (Univ. of Hamburg; Tierärztlichen Hochschule, Hanover; and Max-Planck-Inst., Mariensee, Ger.). 24p.

Results are summarized from a three-year study of vitamin B_{12} absorption in swine. Vitamin B_{12} labeled with cobalt-58 and with cobalt-60 was used as tracer. The effects of the Intrinsic Factor on vitamin B_{12} absorption were investigated. Data are tabulated and discussed. (C.H.)

6147 A/CONF.15/P/1051
THE FATE AND METABOLISM OF PHARMACEUTICS IN THE ANIMAL BODY: INVESTIGATION BY MEANS OF TRACER SUBSTANCES. Bernhard Duhm, Lothar Koester, et al. (Farbenfabriken Bayer Aktiengesellschaft Werk, Elberfeld, Ger.) 19p.

The main features of the metabolism of a radioactively labeled substance, S^{35}-Verophen, were clarified by a continuous series of investigations, using as identification of the metabolites the characteristic biological half life times. Since part of these could experimentally be determined in the renal excretion, they aided in finding the same half life times in the activity curves of the organs, and led to the detection of a further metabolite, which could not be measured in the elimination. Thus, even without knowledge of the chemical constituents, a quantitative statement of the metabolism of a compound can be made with the aid of biological half life times. (auth)

6148 A/CONF.15/P/1053
EXPERIMENTAL IRRADIATION DAMAGE OF THE BRAIN. Norbert Schlimmelfeder (Univ. of Bonn). 16p.

Morphological, cytological, and histochemical changes are described which were induced in the brain tissue of rats by localized doses of 5,000 to 60,000 r x radiation to the cerebellum. Observations were made from 30 minutes up to 20 days after irradiation. A comparison was made between degree of anatomical changes in the cerebellum and the appearance of clinical disturbances in cerebellar function following irradiation as demonstrated by a motion picture film. (C.H.)

6149 A/CONF.15/P/1089
USE OF K^{42} IN THE DETERMINATION OF THE AMOUNT OF K CARRIER IN THE YEAST CELL WALL. E. J. Conway and P. F. Duggan (University Coll., Dublin). 11p.

Potassium ions are actively transported into the cells when glucose in solution is fermented by yeast in the presence of potassium. A procedure is described for

determining the concentration of the cation carrier in this reaction. Potassium ions labeled with potassium-32 were displaced from the carrier by means of excess rubidium, and the displaced potassium ions were measured by determining the radioactivity of the suspending fluid. The carrier system is considered to be a metal redox system, and the reaction mechanisms involved are discussed. (C.H.)

6150 A/CONF.15/P/1099
THE MECHANISM OF UREA METABOLISM. Pradisth Cheosakul (Ministry of Industry, Bangkok, Thailand) and Leslie W. Blide (Albany Medical Coll., New York), et al. 10p.

The rates of urea decomposition in normal, antibiotic-fed, and antibiotic-fed hepatectomized rats were compared following the injection of carbon-14-urea. The effect of silver lactate on urea metabolism in antibiotic-fed rats was also studied. Results indicate that the decomposition of urea is caused mainly by the enzymatic action of gastrointestinal bacteria. It was concluded that rat tissues contain a negligible amount of ureolytic enzymes and that the liver takes an insignificant part in the breakdown of urea. (C.H.)

6151 A/CONF.15/P/1102
UPTAKE OF LABELLED ORTHOPHOSPHATE BY THE YEAST TORULOPSIS UTILIS. RADIOCHROMATOGRAPHIC IDENTIFICATION OF LABELLED PHOSPHATE ESTERS FORMED. Jorma K. Miettinen (Biochemical Research Inst., Helsinki). 13p.

A two-dimensional solvent system was developed for the radiochromatographic analysis of phosphate esters in filter paper. Good resolution of the di- and triphosphates was achieved. The method was applied in a study of the identity of the major phosphorus metabolites in the yeast Torulopsis utilis following the addition of phosphorus-32-labeled orthophosphate to the nutrient growth media. (C.H.)

6152 A/CONF.15/P/1105
THE USE OF RADIOACTIVE ISOTOPES IN AGRICULTURE IN SOUTH AFRICA. P. G. Marais (Western Province Fruit Research Station, Stellenbosch, Union of South Africa). 26p.

The applications of radioisotopes in South African agriculture include the determination of plant available phosphorus, a study of radiation effects on the growth and phosphorus uptake of plants grown in soil treated with P^{32}, and field and laboratory experiments with a neutron moisture meter in various soils. Reference is also made to field experiments with tobacco, maize, and the perennial grass, Eragrostis curvula. (auth)

6153 A/CONF.15/P/1216
FIXATION DU CERIUM 144 RADIOACTIF SUR LES GLOBULES BLANCS. POSSIBILITES D'EMPLOI EN PHYSIOPATHOLOGIE. (Fixation of Radioactive Cerium (Ce_{144}) on the White Blood Cells. Possible Use in Physiopathology.) A. Aeberhardt (Commissariat à l'Énergie Atomique, Paris). 10p.

The fixation of Ce^{144} was studied in suspensions of white blood cells of the rabbit, in suspensions of human white blood cells, and on the white blood cells in the whole blood of the rabbit. The results showed a strong fixation of cerium on the white blood cells, a fixation as strong in vivo as in vitro. The use of Ce^{144} in making white blood cells is prohibited in humans because of its 275-day half life and the energy of its beta rays. However, the properties of Ce^{141} makes its use possible. Ce^{144} can be used in animals. (J.S.R.)

6154 A/CONF.15/P/1218
LA MESURE DU TAUX DE CAPTATION DE L'IODE 127 DANS L'EXPLORATION DE LA FONCTION THYROIDIENNE. (The Iode-127 Uptake Test Its Value as a Diagnostic Aid in the Functional Evaluation of the Thyroid.) R. Fauvert (Beaujon Hospital, Clichy, France and Univ. of Paris); A Loverdo and R. Besson (Beaujon Hospital, Clichy, France). 17p.

The difference between the uptake and excretion of I^{127} and I^{131} was studied. The method used consists of the measurement of the concentration of radioiodine in the thyroid two hours after the injection of a tracer dose, measurement of the radioactivity excreted in the same time, and the determination of the I^{127} excreted. A statistical analysis is presented of the results. (J.S.R.)

6155 A/CONF.15/P/1223
ETUDE GENETIQUE, CYTOLOGIQUE AND BIOCHIMIQUE D'UN MUTANT CHLOROPHYLLIEN DE TOMATE DU TYPE XANTHA, OBTENU PAR IRRADIATION DE GRAINES. (Genetical, Cytological and Biochemical Study of a Chlorophyllian Mutant Obtained by Irradiation of Lycopersicum Esculentum Seeds.) M. Lefort, J. Duranton, J. M. Galmiche, and E. Roux (Commissariat à l'Énergie Atomique, Paris). 8p.

A large number of mutations were observed after the irradiation of seeds of Lycopersicum esculentum with x rays and thermal neutrons. Forty per cent of the mutations were "chlorophyllian," i.e., a quantitative and qualitative modification of chlorophyllian and carotenoid pigments. Cytologic studies of the "Xantha" type of mutant showed that the mutation had stopped the differentiation of the plastid at the stage of elementary lamellae. The inhibition of the plastid growth is related to the lack of the synthesis of carotenoids and chlorophyll. Biochemical studies showed that the mutation is related to a deviation in carbon metabolism. (J.S.R.)

6156 A/CONF.15/P/1224
LES ECHANGES DE SODIUM DES VERTEBRES INFERIEURS ETUDIES A L'AIDE DU ^{24}Na – LEUR INTERPRETATION COMME UNE "EPURATION" D'EAU RADIOACTIVE. (Sodium Exchange in Lower Vertabrates Studied by Means of ^{24}Na – Its Interpretation as a "Clearance" of Radioactive Water.) J. Maetz (Commissariat à l'Énergie Atomique, Paris). 13p.

To determine the sodium exchange in lower vertebrates, the fresh water fish Carassius auratus and the frog Rana esculenta were placed in a limited volume of water (2 to 3 times their own volume) in which the sodium was tagged with Na^{24}. It was observed that the utilization curves for the total concentration of sodium and the radiosodium were very different. The radiosodium is rapidly utilized, while the reduction of the external sodium is slight. A quantitative analysis of the curves gave, for a given animal, a simultaneous measurement of the influx, outflux, and the net flux of sodium. In the Carassius 495, 380, and 115 μg/hr/100 g were found for these different fluxes, respectively, and 550, 380, and 170 μg/hr/100 g were found for the Rana. The rapid utilization of the external radiosodium which was found in all cases was interpretated as a "purification of radioactive water." For water containing 5 μg/ml of sodium, the speed of maximum purification was found to be 100 ml of water/hr/100 g of weight, or a volume of hourly purification equal to the volume of the body. The limit of this "purification power" is a function of the amount of exchangeable internal sodium.

If the quantity of internal sodium is of the order of 80 to 100 mg/100 g of weight, the maximum volume of water which can be purified is 16 to 20 l of water containing 5 μg of sodium/ml. (J.S.R.)

6157 A/CONF.15/P/1225
METABOLISME DE L'ACIDE PHÉNYLÉTHYLACÉTIQUE CHEZ L'HOMME ET LE RAT ET INHIBITION DE LA SYNTHÈSE DU CHOLESTÉROL. (Metabolism of Phenylbutyric Acid in the Organism and Inhibition of the Synthesis of Cholesterol.) G. Milhaud, B. Silver, and J. P. Aubert (Institut Pasteur, Paris). 8p.

Certain derivatives of acetic acid have the property of inhibiting the synthesis of cholesterol in man and in the rat. As the metabolism of these compounds is unknown, phenylbutyric acid-C^{14} was synthesized for the purpose of studying its behavior in the organism. Phenylbutyric acid administered to the rat is conjugated in the liver with glucuronic acid, forming a complex which is eliminated in the urine. This complex was isolated and its chemical and physiological properties were studied. One can obtain this conjugate in vitro by incubating rat liver slices with phenylbutyric acid. The liver slices show no glucuronidase activity under these conditions. In man the glucuronic conjugate is also formed and has been isolated from the urine. The glucuronoconjugate of phenylbutyric acid is a powerful inhibitor of the synthesis of cholesterol from acetate-C^{14} in rat liver slices. Conjugation does not reduce the inhibitory properties of phenylbutyric acid towards cholesterol synthesis. (auth)

6158 A/CONF.15/P/1226
AUTORADIOGRAPHIE et MICRORADIOGRAPHIEL TECHNIQUES d'ETUDE de l'INDUCTION des TUMEURS VEGETALES. (Studies on the Mechanism of Tumour Induction by Autoradiographic and Microradiographic Techniques.) P. Manigault (Inst. Pasteur, Paris). 6p.

Details of the tumor transformation induced in plants by a bacterium, Agrobacterium tumefaciens, are as yet unknown. In the present study, techniques and experiments that were made with radioisotopes in an attempt to elucidate the conditioning of wounded host cells for tumor induction are reported. The experiments were of two types: Inoculation of P^{32}-labeled bacteria into whole plants and into tissues cultivated in vitro and preparation of a bacteria-free tumor-inducting principle by P^{32}-labeled bacteria grown on wound sap. The host and bacteria behavior were studied by autoradiography. Comparison of the P^{32} autoradiographic results was made with evidence obtained with other radioisotopes. Microradiographic studies were made to evaluate the significance of the autoradiographic data. (J.S.R.)

6159 A/CONF.15/P/1227
DISTRIBUTION ET SORT DE L'HISTAMINE RADIOMARQUÉE AU ^{14}C SUR LE NOYAU IMIDAZOL DANS L'ORGANISME ANIMAL. (Fate of Exogenous Histamine in the Body as Studied with Histamine Tagged with ^{14}C on the Imidazol Ring.) Bernard N. Halpern, Thérèse Neveu, and Cedric W. M. Wilson (Centre National de la Recherche Scientifique, Paris). 20p.

It is generally agreed that cellular histamine originates exclusively from histidine and that exogenous histamine does not penetrate the cells. Following intravenous injection of C^{14}-histamine, 80% of the administered histamine disappears after one minute from the circulating blood. The quantity eliminated or destroyed by oxidation in such a short period of time being insignificant and the distribution volume of histamine considerable, a cellular "pump effect" should be considered as the only valid explanation. Determination of C^{14}-histamine in rat tissues proves the tissular fixation of histamine. With this respect the distribution rate in the various tissues calculated five minutes after the injection is as follows: kidneys—25%; striated muscle—20%; liver—16%; skin—12%; small intestine—10%; and whole blood—5%. The study of the relationship C^{14} chemical histamine/biological active histamine allows the measurement of the histamine metabolism of each tissue and provides new and original information on this important tissular function. (auth)

6160 A/CONF.15/P/1228
METABOLISME DU 35S DANS LA PHYSIOLOGIE DE LA REPRODUCTION CHEZ LES MAMMIFERES. (^{35}S Metabolism in the Physiology of Mammals Reproduction.) R. Moricard, S. Gothie, and M. Rodriguez-Galindo (Ecole Pratique des Hautes Etudes, Paris). 6p.

From ovulation to nidation in the uterus, the spermatozoa, the second order ovocyte, and the fertilized egg are free in the genital secretions whose sulfur amount depends on ovarian hormones. The spermatozoa can fix S^{35} in vitro and they seem to be able to metabolize this element during their ascent through the genital tract. In the uterus and in the mucosa of the cervix, there is an intense and fast metabolism of the S^{35} in the guinea pig. In the fallopian tube, fecondation takes place in the secretions in which S^{35} metabolism is at the highest degree at fertilization. As soon as the second polar body is expelled, the pellucida has a very high concentration of S^{35}, whether the latter is injected in the form of $Na_2S^{35}O_4$ or cystine. This concentration is not only due to fertilization, it appears also in unfertilized eggs. In vitro cultures of ovarian ovocytes, tubal eggs, and uterine blastocytes show the protective part played by the pellucida and its concentrating power, a function which does not seem to be performed by the pellucida of first-order ovocytes. (auth)

6161 A/CONF.15/P/1229
SUR L'ABSENCE D'UN POOL METABOLIQUE UNIQUE DU GLYCOCOLLE LIBRE DES TISSUS. (Evolution of the Specific Activity of the Free Glycine of the Tissues.) Georges Schapira, Jean-Claude Dreyfus, Jacques Kruh, Dominique Labie, and Prudent Padieu (Hôpital des Enfants-Malades, Paris). 8p.

The development of the specific activity of the glycine of different tissues was studied as a function of time after injection of glycine-C^{14} in the rabbit. The rabbits were killed after 2 to 35 days and the free amino acids were extracted from the plasma, red blood cells, liver, kidney, brain, muscles, and bone marrow. The glycine was isolated and determined. The results showed that in the case of free glycine there is no common metabolic pool. The long persistance of free labeled glycine in the plasma and the tissues was also noted. (J.S.R.)

6162 A/CONF.15/P/1230
UTILISATION DE MOLECULES RADIO-MARQUEES POUR L'ETUDE DE TISSUS EN SURVIE HORS DE L'ORGANISME. EXPERIMENTATION HUMAINE ET ANIMALE AVEC LE S 35. (The Use of Labelled Molecules in the Study of Living Tissues Outside the Organism. Human and Animal Experiments with Sulphur-35.) J. Verne, J. Bescol-Liversac, and L. Olivier (Centre National de la Recherche Scientifique, Paris). 26p.

The use of labeled molecules on living tissues outside the organism is a very general method. It has numerous

applications, such as realization of identical experimental conditions for different tissues, realization of different experimental conditions for the same tissue, study of the biosynthesis capacity of isolated tissues, study of the effect of toxic, pharmacodynamic, and metabolic agents independently of secondary reactions, use of small quantities of labeled substances, and experiments on human tissues. The interpretation of results is made on histologic curves and by microcounting and histoautoradiography. The results are both morphological and physiological and qualitative and quantitative. General results obtained with $Na_2S^{35}O_4$ on isolated tissues are reviewed, and some examples from studies on tissue sulfur–sulfate distribution are given. (tr-auth)

6163 A/CONF.15/P/1236
ETUDE COMPAREE DES EFFETS DES RAYONS X ET DU ^{32}P SUR LA DEGRADATION ET LA SYNTHESE DES ACIDES NUCLEIQUES DE LA MOELLE OSSEUSE ET DE LA RATE, CHEZ LE RAT. (Comparative Study of the Effects of X Rays and of ^{32}P on the Degradation and Synthesis of the Nucleic Acids of the Bone Marrow and the Spleen in Rats.) P. Mandel, C. Jaudel, et al. (Univ. of Strasbourg). 11p.

The effect of various doses of x radiation and P^{32} injections on the ribonucleic and desoxyribonucleic acids of the bone marrow and spleen was studied. The evolution of the absolute quantity was studied. The degradation for RNA for doses of 325, 500, 700, 1000, and 1500 r was 42, 55, 60, 65, and 72%, respectively, and 66, 70, 80, 85, and 91% for the same irradiation of DNA. Regeneration after sublethal doses occurs after the fourth day. Administration of 200, 300, or 400 μc of P^{32} produces on the fourth day in the marrow an average degradation of 33, 51, and 62% for RNA and 46, 44, and 72% for DNA. The effect of 200 μc is therefore of the same order as 325 r of whole-body irradiation, and that of 400 μc is close to the sublethal dose of 700 r. In the case of the spleen, the effects of 400 μc are in the vicinity of those of 500 r. (J.S.R.)

6164 A/CONF.15/P/1237
LES EFFETS DES RADIATIONS IONISANTES SUR CERTAINS VEGETAUX. (ETUDE DE LA RESTAURATION, DES EFFETS PHYSIOLOGIQUES ET GENETIQUES.) (The Effects of Ionising Radiations on Certain Plants, with Studies on Restoration, Physiological and Genetic Effects.) P. Lamarque, J. Gary-Bobo, et al. (Univ. of Montpellier, France). 29p.

The effect of x and gamma radiation on rice grains (Oryza sativa L.) and grape pips (Vitis vinifera L.) was investigated. The study of the physiological effects showed a delay in the germination and growth, a decrease of the germinating faculty, and the appearance of numerous anomalies. These effects appear to increase with an increase of the dose administered. The restoration of lesions caused by the radiations follows a sigmoid curve comparable to that obtained for other biological materials. The study of the genetic effects has as yet yielded no precise results. (J.S.R.)

6165 A/CONF.15/P/1239
UTILISATION DES ECHANGEURS D'IONS ET TRAITEMENT PRECOCE DE LA CONTAMINATION RADIOACTIVE PAR VOIE DIGESTIVE. (Use of Ion Exchangers and Early Treatment of Radioactive Contamination in the Digestive Tract.) Georges Michon and Marie-Josèphe Guilloux (Commissariat à l'Énergie Atomique, Paris). 11p.

The possibility of using ion-exchange resins to prevent the absorption of radioisotopes into the circulatory system after ingestion of radiocontaminants was tested on rats. After administration of the solutions containing carrier-free $Sr^{90}Cl_2$, the resin, in the 100 to 250 mesh range, was introduced by esophagial tubing directly into the stomach. After the experiments, which last from 11 to 76 days, the animals were killed and the activity in various organs, especially the skeleton, was measured. The study of the daily excretion shows the importance of fecal excretion during the first three or four days in the decrease of the radioactivity retained. A measurement of the amount in the skeleton showed that all the cation resins used were efficient in limiting the absorption of activity, but the sulfonic resins in the ammonia form gave the best results. The ion-exchange resin must be administered not more than 45 min after the ingestion of Sr^{90} to be effective. The sex does not appear to have an effect, but the treatment is more efficient for the adult than for the young animal. (J.S.R.)

6166 A/CONF.15/P/1277
LES EFFETS BIOLOGIQUES DES IRRADIATIONS À GRANDES DOSES UNIQUES CHEZ L'HOMME EN ÉTAT DE NARCOSE. (The Radiotherapy of Tumors in Man under Narcosis). O. Costăchel (St. Grigoresco de l'Inst. Oncologique, Bucharest). 17p.

Experimental investigations of radiotherapy under narcosis were made. It was shown that narcosis largely suppresses the general harmful effects of large local irradiations in animals and men. The effects on the skin are much less. However, the radiobiological effect is different for various organs and parts of the body. (J.S.R.)

6167 A/CONF.15/P/1278
DONNEES EXPERIMENTALES ET CLINIQUES CONCERNANT L'ESSAI D'UNE CLASSIFICATION DE L'EFFET RADIOBIOLOGIQUE SUR LES ORGANISMES SUPERIEURS (MAMIFERES). (Experimental Findings on a New Classification of the Biological Effects of Radiation on the Higher Animals (Mammals). O. Costăchel (St. Grigoresco de l'Inst. Oncologique, Bucharest). 36p.

A new classification of radiobiological effects, based on effects in radiation therapy, is proposed. The principles of the system are the assumption of a biological effect which is different from the physico-chemical effect of radiation, the fact that the direct biological effect consists of the direct and indirect physico-chemical effects, and the theory that there is a complex indirect biological effect. Experimental evidence is offered in support of the classification of biological effects into direct radiobiological effects and indirect biological effects. The possibility of extending this classification to radiosensitivity and radioprotection are considered briefly. (J.S.R.)

6168 A/CONF.15/P/1289
L'INFLUENCE DES RADIATIONS X SUR LES RATS TRAITÉS AVEC DU MERCAPTO-BENZO-THIAZOLE (MBT). (Effects of X-Rays on Mercaptobenzothiazole Treated Mice.) A. Eugène Pora and Mircea Pop (Univ. of Cluj). 7p.

The susceptibility and resistance of the central nervous system to ionizing radiations were studied. Food-conditioned reflexes were developed in mice. Once these reflexes were well established, the animals were divided into a control group and a sample group. The sample group received 4×10^{-5} mole of mercaptobenzothiazole per 20 g of body weight. Both groups were

irradiated with 700 r of x radiation. All the controls died within two days, whereas all the mice which had received mercaptobenzothiazole survived. The surviving mice, however, lost all the conditioned reflexes. More than three weeks were required for the reflexes to be restored to their initial value. Although the cerebral cortex is very susceptible to radiation, irradiation does not cause modifications in the anatomical structure of the cortex. Mercaptobenzothiazole confers effective radioprotection, but it does not prevent functional cortical disturbances. (auth)

6169 A/CONF.15/P/1290
L'INFLUENCE DE LA SALINITÉ EXTÉRIEURE SUR LA PÉNÉTRATION DE $P^{32}O_4H_2Na$ PAR LES BRANCHIES DE RUTILUS RUTILUS L. (Effect of the External Salt Concentration on the Penetration of $P^{32}O_4HNa_2$ through the Branchiae of Rutilus Rutilus L.). A. Eugène Pora (Univ. of Cluj) and Albert I. Vertunov (Veterinary Research Inst., Moscow). 4p.

The uptake of labeled NaH_2PO_4 by the roach Rutilus rutilus L. was studied as a function of the water salinity. After one or two hours in solutions with various concentrations the fish were killed, and the activity of the blood was determined. The results showed that the phosphate uptake increases with increasing salinity and increasing exposure. (J.S.R.)

6170 A/CONF.15/P/1291
L'ABSORPTION INTESTINALE DE $P^{32}O_4H_2Na$ CHEZ RUTILUS RUTILUS L., EN FONCTION DE LA QUANTITÉ DE PHOSPHATE DU SANG. (The Intestinal Absorption of $P^{32}HNa_2$ in Rutilus Rutilus L., as a Function of the Total Phosphatemia.) Alexandre A. Kudriavtzev (Veterinary Research Inst., Moscow) and Eugène A. Pora (Univ. of Cluj). 9p.

The intestinal absorption of phosphates in higher animals is inhibited by an increase in the total phosphatemia. This was investigated on roach (Rutilus rutilus L.) caught in the lakes around Moscow during November and December of 1957. It was shown that the phosphates dissolved in the external medium reach the bloodstream of the fish through its branchiae. They accumulate in the organs only in very small quantities and are excreted almost entirely by the kidneys. The phosphates contained in the food are absorbed by the intestines. They accumulate in the liver, encephalon, and muscles. If the amount absorbed is large as compared to that which is so accumulated, the phosphates also are excreted by the kidneys. When a large amount of phosphates is supplied in the food, in addition to those absorbed from the external medium through the branchiae, the absorption and accumulation of the former will be reduced. If the accumulation of phosphates following branchial absorption be rated as 1, the deposition following intestinal absorption would be rated at about 50 and that noted for simultaneous branchial and intestinal absorption would be about 10. Thus it is that an increase in the phosphatemia inhibits the absorption and accumulation in the body organs of the phosphates present in the food. Even if it is absorbed, this phosphate is excreted by the kidneys in large amounts, showing that it can be transformed into an organic form which is systemically useful. (auth)

6171 A/CONF.15/P/1295
RECHERCHES SUR LA PENETRATION DU ZINC DANS LES CARYOPSES ET LES SEMENCES AU MOYEN DE LEUR TRAITEMENT PAR $ZnSO_4$ MARQUE AVEC DU ZINC RADIOACTIF 65. (Research Into the Effect of Zinc on the Biological Processes of Some Plants with the Help of Radioactive Zinc (Zn^{65}).) R. Ripan, E. Pop, I. Ciobanu, T. Marco, and G. Marco (Université "Victor Babes," Cluj). 10p.

A study was made of the effect of small amounts of zinc on the growth of the seeds of some cereals. The study was conducted by varying the time and the zinc concentration. Zn^{65}-labeled $ZnSO_4$ was used. It was shown that the penetration of zinc into the caryopses and seeds was slow in Zea mays and more rapid in Phaseolus vulgaris. An increase in the uptake occurred in both cereals with an increase in the concentration of the solution. In a comparison of the zinc distribution, it was found that the pericarp of the caryopses of Zea mays retains a larger quantity than the seed tegument of Phaseolus vulgaris, and the endosperm a smaller quantity than the seed cotyledon. (J.S.R.)

6172 A/CONF.15/P/1298
CONTRIBUTIONS AU PROBLEME DE LA RADIOSTIMULATION DES SEMENCES D'ARBRES FRUITIERS ET DE VIGNE. (Radioactivity Stimulation of Fruit-Tree and Grape-Wine Seeds). Th. Bordeianu, Gh. Constantinesco, Gh. Anghel, D. Teodoresco, N. Băjesco, I. Poenaru, and M. Mihalco (Inst. of Agricultural Research of Rumania). 12p.

The effect of beta radiations on the seeds of fruit trees and grapevines was studied. P^{32} was used as the radiation source. Treatments were made using solutions of different concentrations and varying exposure times. The germination was studied to establish the relation between the dose and the radiation exposure and the different aspects of the germination process. The stimulatory and inhibitory effects of the radiation on seed germination were determined. The results are graphed. (J.S.R.)

6173 A/CONF.15/P/1299
THE EFFECT OF HARD ELECTROMAGNETIC RADIATIONS ON THE CHLAMIDOSPORES OF CERTAIN SPECIES OF TILLETIA AND USTILAGO. A. Săvulescu, D. Beceresçu, M. Mihalcu, and A. Abramovici (Inst. of Agricultural Research of Rumania). 8p.

Different intensities and exposures of gamma and x radiations have been tested on the germination of chlamidospores of some closely related fungi. This work was carried on with Co^{60} gamma radiation and a 180-kv x-radiation source. The relation between the germinative capacity, and the intensity and treatment exposure has been observed, as well as the effects on different phases of germination. It has been sought also to find a differentiation between species of Tilletia known as wheat parasites. (auth)

6174 A/CONF.15/P/1300
L'INFLUENCE DE L'IRRADIATION AVEC DES RAYONS X ET DES NEUTRONS THERMIQUES SUR LES GRAINES DE CEREALES ET DE MAIS. (The Influence of Roentgen Radiation and Thermic Neutrons Upon Cereals and Corn). Al. Priadcenco, A. Melacrinos, and P. Avrămoaie (Inst. of Agricultural Research of Rumania). 11p.

Seeds from several species of wheat, barley, oats, and corn of Rumanian origin were irradiated with different intensities of x radiation and thermal neutrons. The results showed that radiation inhibits the germination of the grains. The plants from the irradiated grains have a slower growth and development, a prolongment of the vegetative cycle, a pronounced sterility, and a

greater sensitivity to diseases. The detailed results are tabulated. (J.S.R.)

6175 A/CONF.15/P/1309
REACTIONS THYROIDIENNES DANS DES ETATS EXPERIMENTAUX AIGUS ETUDIEES A L'AIDE DE L'IODE RADIOACTIF I^{131}. (Thyroid Reactions in Acute Experimental Conditions, as Investigated with the Help of Radioactive Iodine I^{131}). St. Milcou, V. Săhleanu, R. Holban, and Al. Bojinescou (Inst. d'Endocrinologie "C. I. Parhon," Bucharest). 6p.

The thyroid reactions were studied in control rats and guinea pigs and in animals receiving cortisone. The capture of I^{131} by the thyroid was followed under experimental conditions where the harmful agent used represented the microbic toxic component or the antigenic component. An increase in the rate of capture was noted after 24 hr in guinea pigs which had received diphtheria toxin, followed by a drop with finally a second increase. These results showed that there is a definite thyroid functional cycle in response to a toxic aggression. In the case of guinea pigs which were given cortisone at the same time, no such drop was noted. This suggests that thyroid inactivation is connected to the proper functioning of the corticotropic axis and that ACTH release may modify the thyroid reactions. In the rats which were given mixed antithyroid–parathyroid vaccine subcutaneously, a significant drop in the rate of capture was noted. When associated with cortisone, this treatment raised the capture rate somewhat among the controls. This result also suggests that the inactivation of the thyroid in stress is mainly dependent on ACTH release and not on impregnation with the corticoids. (J.S.R.)

6176 A/CONF.15/P/1310
LES TISSUS UTILISANT L'HORMONE THYROIDIENNE MARQUEE "IN VIVO" PRESENTENT DES RADIOACTIVITES DIFFERENTES. (Tissue Utilization of Tagged Thyroid Hormone In Vivo with Different Time Constants). S. M. Milcou, E. Costiner, D. Nicolescou-Zinca, and L. Vaisler (Inst. d'Endocrinologie Académie des Sciences, Bucharest). 22p.

The tissue utilization of thyroid hormones were studied in white rats which had received a tracer dose of carrier-free I^{131}. The rats were sacrificed in batches of 10 every hour for 72 hours. The radioactivity of the tissues from these rats was measured and activity curves for the tissues were drawn. The investigation of the changes in radioactivity of the tissues with time showed that the thyroid functional units having different time constants excrete different iodine compounds. The various organs utilize different amounts of these compounds, with some organs only using one. Graphs for the activity of the blood, thyroid, stomach, liver, intestines, pancreas, spleen, kidney, lungs, muscle, and saliva glands are given. (J.S.R.)

6177 A/CONF.15/P/1311
L'INFLUENCE DU THYMUS SUR L'INCORPORATION DU P^{32} AU COURS DE LA CANCERISATION. (The Effect of the Thymus on Phosphorus Metabolism in Experimental Cancer P^{32} Incorporation in Cancerization.) C. I. Parhon, I. Potop, et al. (Inst. d'Endocrinologie "C.I. Parhon," Bucharest). 25p.

A study was made of the variations of phosphorus metabolism in the pre-cancer, cancer, and tumor resorption stages. The uptake of phosphorus in the liver, spleen, testicles, kidney, suprarenals, and the tumor tissue of male white rats in different stages of cancerization was determined. The velocity of the incorporation of P^{32} in the different organs of the rat during the processes of canceration varied according to the development or retrogression of the tumor by thymus extract. In general, after the transplantation and during the development of the tumor, the speed of P^{32} uptake increases. The administration of thymus extract produces itself a stimulation of the phosphorus exchanges in the different tissues, depending on the length of the administration. It appears that the thymus inhibits the development of the tumors by decreasing the phosphorus metabolism. The incorporation of phosphorus under different forms is effected by the different stages of the canceration process. The kinetics of the phosphorus exchange in canceration is dependent on the state of the neoplastic process and on the length of the administration of thymus extract. Histopathologically, the administration of thymus after the grafting of the tumors produces a regression of the cancerous lesions in the case of fusocellular sarcoma, shown by the appearance of necrosis and cellular liquefaction with phenomena of tumor resorption and decrease of cellular and nuclear atypy. (J.S.R.)

6178 A/CONF.15/P/1312
L'HORMONE EPIPHYSAIRE INTERVIENT DANS LA DYNAMIQUE DU METABOLISME DE L'IODE. (Role of the Pineal Body Hormone in Thyroid Function.) S. M. Milcou, E.Costiner, et al. (Academie des Sciences, Bucharest). 37p.

To evaluate the action of the pineal body hormone on thyroid function, hyperactivity of the epiphysis was experimentally induced by administering pineal body hormone four hours before the experiment and then every four hours during the experiment. Iodine tagging was achieved by the intraperitoneal injection of "carrierless" I^{131}. The animals, which had been divided into batches of 10, were sacrificed every 2 hours until 48 hours had elapsed following the radioactive tagging. Measurements on the radioactivity of the thyroid and of the blood were carried out in vitro. The values obtained were used in order to draw up simultaneous radioactivity curves applicable to the total radioactivity and to that attributable to inorganic and organic iodine, respectively. The curves showing the variation in the radioactivity reveal a delayed action of the pineal gland hormone which is different according to whether the functional thyroid units have a large or small time constant. (auth)

6179 A/CONF.15/P/1313
L'INFLUENCE DE LA THYROXINE, DE L'EPIPHYSE ET DE L'HORMONE THYREOTROPE SUR L'INCORPORATION DU P^{32} DANS LE CERVEAU. (The Effect of Thyroxine, Pineal Body Hormone, and Insulin on the Energetic Metabolism of the Brain P^{32} Fixation). S. M. Milcou, I. Pótop, C. Ciocîrdia, and E. Juvină (Inst. d'Endocrinologie de l'Academie des Sciences, Bucharest). 11p.

A study was made of the effect of thyroxine, pineal body hormone, and insulin on phosphorus incorporation in the brain. Thyroxine and the pineal body hormone increases phosphorus metabolism. The administration of methylthiouracil causes a decrease in phosphorus metabolism. In thyroidectomized rats, thyroxine maintains phosphorus incorporation at the same level as in the control animals. The administration of insulin decreases phosphorus uptake. (J.S.R.)

6180 A/CONF.15/P/1314
L'INHIBITION DE LA CAPTATION DU PHOSPHORE P^{32} CHEZ LES RATS ALBINOS AU NIVEAU DES OVARIES

ET DE L'UTERUS APRES L'ADMINISTRATION DE L'EPIPHYSEHORMONE. (The Inhibition of P^{32} Capture in the Ovaries and Uterus of White Rats Following the Administration of Pineal Hormone.) Stefan M. Milcou, Al. M. D. Serban, et al. (Inst. d'Endocrinologie "C. I. Parhon," Bucharest). 8p.

A study was made in the rat of the modifications in the rate of P^{32} uptake by the ovaries and uterus following the administration of pineal hormone. A dose of 10 μc of P^{32} was injected intraperitoneally in nubile and non-nubile female rats which had received pineal hormone for ten days. The animals were sacrificed after 4 and 24 hours. The results showed that the rate of P^{32} uptake was reduced in the ovaries and uterus. Antuitrin S and pineal hormone were injected into non-nubile rats to study a possible inhibition of gonadotropin by this hormone. Gonadotropin causes an increase in P^{32} uptake by the ovary and uterus with a progressive tendency for the first 24 hours. Pineal hormone causes a decrease in the degree of P^{32} uptake produced by the gonadotropin. (J.S.R.)

6181 A/CONF.15/P/1341

OVICIDAL EFFECT OF ^{60}Co GAMMA RAYS UPON PARASITE EGGS AND BACTERIA. Toshizo Titani, Masaharu Kondo, Hiroshi Suguro (Tokyo Metropolitan Univ.) and Tomoo Takahashi (Shionogi Pharmaceutical Co., Ltd., Japan). 11p.

Infection with ascaris is one of the chronic diseases widely spread in Eastern Asia. The main mediators of this infection are fresh vegetables polluted with ascaris eggs in the larval stage. An investigation was made of the ovicidal effects of exposure to gamma radiation on ascaris eggs with a view to investigating its applicability as a means of disinfection. It was found that doses of 7 kr are effective for suppressing the development of the larval stage. The radiosensitivity of E. coli, B. subtilis, and aqueous solutions of vitamins B_1 and C was also investigated. Data are presented graphically. It was concluded that irradiation with a low dose rate is desirable for sterilization of vegetables and the preservation of heat-labile vitamins. (C.H.)

6182 A/CONF.15/P/1342

DETECTION OF LATENT FINGER-PRINT BY AUTORADIOGRAPHY. Toyosaburo Takeuchi, Masakazu Sakaguchi, Yuzuru Nakamoto, and Syoichi Kadokura (Toyama Univ., Japan). 3p.

An autoradiographic method is described for the detection of latent finger prints. Radioactive compounds are allowed to react with substances contained in a latent print, after which the material is placed in contact with photographic film. Finger prints were detected after a week on metal, glass, paper, and textile fabrics. (C.H.)

6183 A/CONF.15/P/1343

STUDIES ON DISTRIBUTION OF ^{32}P-TAGGED PLATELETS IN RABBITS. Kyoichi Yuasa, Hisao Morita, Masateru Toyoda, Kikuyo Ozumi, Shigeo Kikuchi, Fumio Mitsui, Yasuhiro Uchiyama, and Atsushi Ohshita (Toho Univ., Tokyo). 6p.

The tissue distribution of injected blood platelets was studied in rabbits using platelets tagged with phosphorus-32. Data are presented graphically. (C.H.)

6184 A/CONF.15/P/1344

DIFFERENT RADIATION SENSITIVITY OF THE SILKWORM TESTIS TO THE DECLINE OF EGG HATCHABILITY, WITH SPECIAL REFERENCE TO CYTOLOGICAL AND BIOCHEMICAL EVIDENCE. Makita Kogure and Makoto Nakajima (Tokyo Univ. of Agriculture and Tech.). 19p.

Male silkworms were irradiated with cobalt-60 gamma radiation at various stages during spermatogenesis. After mating, the number of unfertilized eggs and of dominant lethals induced by gamma irradiation was determined. Results are compared with those obtained following the oral administration of phosphorus-32 to both males and females. (C.H.)

6185 A/CONF.15/P/1345

STUDIES ON THE VIRULENCE OF TUBERCLE BACILLI BY USING ^{32}P-LABELLED BACILLI. Yuichi Yamamura (Kyushu Univ., Japan). 24p.

Tubercular bacilli labeled with phosphorus-32 were injected into animals and their fate in vivo followed in a study of the biochemical factors affecting the virulence of the organisms. Results show that the virulent bacilli are more resistant to in vivo destruction and elimination mechanisms than the avirulent strain. Factors affecting virulence are discussed. (C.H.)

6186 A/CONF.15/P/1351

MUTATIONS OF RICE INDUCED BY RADIOISOTOPE ^{32}P. Isao Masima and Takeshi Kawai (National Inst. of Agricultural Sciences, Japan). 17p.

The mutagenic effect of internal radiations from absorbed phosphorus-32 was examined in rice plants. Characteristics of the radioinduced mutants were investigated to see whether the induced mutations were suitable for plant breeding. Two-hundred and eighty-three mutant lines were obtained which bred true with different characters in the fourth and fifth generation. Field trials over a six year period resulted in some promising lines having high productivity. Some physiological and genetic effects of phosphorus-32 are described. Data are tabulated on yields and characteristics of mutant lines. (C.H.)

6187 A/CONF.15/P/1352

STUDY ON THE IMPROVEMENT OF FERTILIZER DRESSING AND SOIL MANAGEMENT IN THE RICE FIELD. FIELD EXPERIMENT ON RICE USING 32-P LABELED FERTILIZER. Susumu Nishigaki, Masao Shibuya, Takeo Koyama, and Ikuko Hanaoka (National Inst. for Agricultural Science, Tokyo). 19p.

Fertilizers labeled with phosphorus-32 were used to obtain basic information to improve the yield of rice from fields of volcanic ash soil. Safe limits were determined for radioisotope concentration in fields where manual labor is employed. (C.H.)

6188 A/CONF.15/P/1353

THE UTILIZATION OF Ca BY CROP PLANTS FROM Ca-45 LABELED TIME NITROGEN. Shingo Mitsui and Kiyoshi Kurihara (Tokyo Univ.), and Susumu Sonoda, Shoichi Sawayanagi, Teizo Morishita, Toru Hirayama, Kazuyoshi Hamada, and Akira Terakawa (Showa Denko Kabushiki Kaisha, Tokyo). 17p.

Lime nitrogen labeled with calcium-45 was used in a study of the utilization of calcium in lime nitrogen by wheat. Results indicate that calcium in lime nitrogen can serve as a good source of nutrient calcium as well as an acid neutralizing agent. (C.H.)

6189 A/CONF.15/P/1354

DETOXICATION AND REMOVAL OF RADIOACTIVE STRONTIUM IN THE RAT. Yosoji Ito and Susumu Tsurufuji (Tokyo Univ.). 16p.

A review is presented from studies on the effec-

tiveness of various chelating agents for inhibiting the bone deposition of radiostrontium. Sodium tricarballylate, citraconate, tartrate, lactate, citrate, and propane-1,1,2,3-tetracarboxylate all markedly inhibited bone deposition of radiostrontium in rats. Data are included on the influence of dietary levels of calcium and phosphorus on radiostrontium uptake. (C.H.)

6190 A/CONF.15/P/1385
INVESTIGATION OF CENTRAL HEMODYNAMICS BY MEANS OF SELECTIVE QUANTITATIVE RADIOCARDIOGRAPHY. Gabriele Monasterio and Luigi Donato (Univ. of Pisa). 28p.

The volumes of blood in the cardiopulmonary circulation and their rate of renewal were measured by quantitative analysis of radiocardiographic tracings. The techniques which were developed represent a new and accurate tool both for physiological investigation of cardiopulmonary circulation and for the clinical study of heart patients. (auth)

6191 A/CONF.15/P/1386
A STUDY OF PHAGE INACTIVATION BY ASSIMILATED P32. C. Castagnoli and F. Graziosi (Univ. of Rome). 18p.

Results are reported from a study of bacteriophage inactivation following assimilation of phosphorus-32. Data are included on inactivation due to external nonassimilated phosphorus-32, the inactivation of dry phage by assimilated phosphorus-32, and the effect of temperature and state of the medium on the inactivation of labeled bacteriophage. (C.H.)

6192 A/CONF.15/P/1387
INCORPORATION AND METABOLISM OF S^{35}-METHIONINE DURING THE EARLY DEVELOPMENT OF THE SEA URCHIN EGG. A. Monroy, E. Nakano, and G. Giudice (Univ. of Palermo, Italy). 6p.

Results are reported from investigations in which methionine labelled with sulfur-35 was incorporated into sea urchin eggs. The incorporation was accomplished in the unfertilized egg, and the distribution of the tracer among the cell components was followed during development and in parthenogenetically activated eggs using cell fractionation and autoradiographic methods. Special attention was devoted to the mitochondria which appear to be unable to take up the tracer in the unfertilized eggs; the incorporation begins almost immediately after fertilization, however, and its rate increases exponentially. The metabolic pathways of the labelled compound were followed throughout development. (auth)

6193 A/CONF.15/P/1389
ABSORPTION AND TRANSFER OF PHOSPHORUS (P^{32}) IN HEALTHY AND DISEASED PLANTS. E. Baldacci, E. Betto, R. Foa, and A. Volpi (Univ. of Milan). 12p.

A series of investigations, using phosphorus-32 as a tracer, was carried out to measure the uptake through the roots and leaves in healthy plants and the effects of disease on phosphorus uptake in plants. (C.H.)

6194 A/CONF.15/P/1390
INVESTIGATIONS ON RECOVERY PROCESSES FROM RADIATION DAMAGE INDUCED IN THE LYMPHNODES OF THE RAT. C. Biagini, D. Guerritore, and L. Bellelli (Univ. of Rome). 10p.

The total weight of the lymph nodes was determined, together with the number of cells per volume unit and the total amount of DNA, of nitrogen, and of phosphorus. DNA was extracted from the lymph nodes of some groups of rats, each composed of ten animals, and the P^{32} uptake was measured. The pyknotic index was measured, and frequency distributions of nuclear diameters in the individual populations of lymphocytes were plotted. The decrease in total DNA in a population of cells irradiated with 100 to 500 rad of gamma rays produced by a Co^{60} source was ascribable to the decrease in the number of cells. The DNA content in each single cell was unaffected. Some modifications, such as the decreased uptake of P^{32} in DNA and the shift in the frequency distribution of the karyometric data, persist in the lymphatic tissue for a long time, even after the tissue has returned to normal in qualitative morphological terms. The results, biometrically analyzed, are presented in graphic form. (auth)

6195 A/CONF.15/P/1391
X-RAY INDUCED MUTATIONS IN POLYGENIC SYSTEMS. A. A. Buzzati-Traverso and R. E. Scossiroli (Univ. of Pavia, Italy). 9p.

Polygenic systems controlling quantitative characters have been shown to undergo spontaneous as well as x-ray-induced mutation. A number of polygenic systems controlling physiological and morphological traits were analyzed in a series of experiments. The increase in genetic variation induced by the treatments allowed a very marked shift in the mean value of several characters that were subjected to natural and artificial selection. In one set of experiments populations of Drosophila melanogaster in approximate numerical equilibrium were irradiated with 500, 1,000, 2,000, and 4,000 every two weeks, while control populations were kept in similar conditions but with no treatment. Both sets of populations originated from isogenic strains. After a number of generations it became evident that improvement in several traits affecting the fitness of the individuals was more rapid in the treated than in the nontreated populations. A genetic analysis of the traits affected showed that they were controlled by polygenic systems. In a second set of experiments strains that had been subjected to artificial selection for high and low number of sternopleural bristles for many generations and had reached a point where further selection was not giving any response, were x-rayed and further selected. While the mean number of bristles did not change appreciably in the control lines, in the treated lines it reached much higher levels in the plus-selection experiments, but remained unchanged in the minus-selection experiment. In both cases a marked increase in the genetic variability of the irradiated lines was demonstrated. In a third set of experiments an attempt was made to discriminate whether the observed increase in the genetic variability after x-ray treatment was due to mutations in polygenic systems or to the release of hidden variability, made possible through an increase in the rate of recombination produced by the effects of x rays. The results confirmed that the examined polygenic systems undergo spontaneous and x-ray-induced mutation. Applications of the findings in studies on problems of evolution and in plant and breeding programs are discussed briefly. (C.H.)

6196 A/CONF.15/P/1392
CHANGES OF RADIOSENSITIVITY DURING MEIOSIS IN SACCHAROMYCES CEREVISIAE. G. E. Magni (Univ. of Pavia, Italy). 10p.

Variation of radiosensitivity during meiosis was demonstrated in Saccharomyces cervisiae. (C.H.)

6197 A/CONF.15/P/1404
MOSAIC STRUCTURE OF CLAY COLLOIDS AS REVEALED BY RADIOACTIVE INDICATORS. M. A. Islam (Univ. of California and Univ. of Dacca, Pakistan). 9p.

By the use of radioactive calcium the Aiken clay was found to adsorb cations also, in addition to its phosphate adsorption capacity. Both lettuce and barley plants were found to adsorb radioactive calcium by contact. Cataphoratic movements showed the Aiken clay to be negatively charged, i.e., the Aiken clay though negatively charged can adsorb both negative and positive ions, and the plant can absorb either ion by contact. This behavior of Aiken clay was explained by assuming a mosaic appearance for Aiken clay, i.e., the colloidal particles of Aiken clay have both negative and positive spots on their surfaces. (auth)

6198 A/CONF.15/P/1405
ROLE OF CALCIUM IN RADIATION INJURY. M. H. Toosy (Nishtar Medical Coll., Multan, West Pakistan). 19p.

Results are presented from a study on the effects of beta particles on the skin of mice. A 90-mc strontium-90 applicator was used as the radiation source. The influence of calcium content of the skin and the effects of various injected hormones on skin reaction were investigated. The hormones employed increased the calcium content of the epidermis significantly. An association was noted between calcium content and the reduced tendency of the irradiated epidermis to ulcerate. The relationship of irradiation, endocrines, and calcium metabolism is discussed. (C.H.)

6199 A/CONF.15/P/1436
THE RADIOSENSITIVE PHASE IN PLANT GERMINATION. Richard Biebl (Univ. of Vienna). 14p.

A detailed study was made of the radiosensitivity of wheat and soja seeds during various stages of germination. Data are summarized. (C.H.)

6200 A/CONF.15/P/1438
INVESTIGATION OF THE METABOLISM OF TISSUE IN CULTURE WITH RADIOACTIVE TRACERS. E. Broda, O. Suschny, and G. Kellner (Univ. of Vienna). 12p.

The metabolism of various kinds of tissues of animal origin in culture was followed radiochemically. The tissue was fed substrates containing radiocarbon, and the activity of the metabolites determined with a Geiger counter after a period of incubation. Differences in metabolism in normal and cancer cells were investigated. A method is described for counting the cells in cultures based on the incorporation of radiophosphorus into the DNA of the nuclei during cultivation in the presence of phosphate of known specific activity. (C.H.)

6201 A/CONF.15/P/1442
THE USE OF RADIOCOLLOIDS IN THE STUDY OF HEPATIC CIRCULATION IN MAN. K. Fellinger, R. Höfer, and H. Vetter (Vienna Univ.). 10p.

Applications of radiocolloids in the study of hepatic circulation are reviewed. Preparations considered include chromic phosphate labeled with phosphorus-32, colloidal gold-198, colloidal iron saccharate labeled with iron-59, and denatured human serum albumin labeled with iodine-131. The advantages and disadvantages of each are discussed. One disadvantage of chromic phosphate lies in the fact that the short range of the phosphorus-32 beta particles necessitates frequent blood sampling. The other preparations allow external counting of the peripheral blood flow and also enable the use of semilogarithmic counting rate meters and automatic chart recorders. Assumptions are discussed on which the calculation of liver blood flow from colloid disappearance curves is based. Various factors which may be sources of error are discussed. These include particle size, speed of mixing within the circulation, and extraction efficiency of the liver. Clinical interpretations of the data are discussed. The combination of this technique with a simultaneous determination of the rate of disappearance of bromsulfalein dye from the circulation was found a useful tool for determining the functional state of the liver. (C.H.)

6202 A/CONF.15/P/1472
ABSORPTION AND DISTRIBUTION OF LABELLED RUBIDIUM IONS IN YOUNG INTACT BARLEY PLANTS. R. J. Helder (State Univ. of Groningen, Netherlands). 10p.

The rubidium ion was used in these absorption studies because of the similarity of the rubidium and potassium ions, so that much knowledge about the behavior of the potassium ions can be gathered by using rubidium salts. The availability of a very useful radioactive isotope greatly facilitates determination and, in addition, renders it possible to study exchange phenomena. If barley plants were pretreated in various salt solutions marked and wide differences in subsequent rubidium absorption capacity were found. The results pointed to specific effects of various ions during the pretreatments. The rate of rubidium uptake could be about constant for at least the first six hours of an experiment. Afterwards severe depressions in the absorption ability occurred followed by a resumption of the uptake at about its initial speed. Interesting data were obtained in experiments in which plants were transferred to various unlabelled solutions after they had been allowed to absorb labelled rubidium for some hours. Only a small fraction, if any, of the rubidium absorbed proved to be exchangeable. However, release of rubidium previously absorbed took place in rubidium sulfate, potassium sulfate, and potassium nitrate solutions. A release to water could be observed provided previous rubidium absorption had taken place in the absence of calcium sulfate. The transfer of rubidium ions, previously absorbed, was also effected by the ionic composition of the medium and the presence of metabolic inhibitors. The results suggested that at any moment part of the rubidium ions present in the roots are in a mobile state. Their final distribution is influenced by the changes in the structural and functional features of the symplasm of the roots brought about by the various external conditions. (auth)

6203 A/CONF.15/P/1488
THE VALUE OF ROSE BENGAL I^{131} AS A LIVER FUNCTION TEST IN HEPATIC BILHARZIASIS. F. Sallam, H. Daw, et al. (Egyptian Atomic Energy Commission, Cair). 7p.

Schistosoma infection is endemic in Egypt, and its intestinal variety produces definite pathological changes in the liver due to its embolization with schistosoma ova. Antimony compounds, which are liver toxins, are used in the therapy of schistosoma infection at the various stages. An evaluation of liver function at different stages after infection was made with iodine-131 labeled rose bengal using γ-spectrometric techniques. Results are compared with results from thymol turbidity and other liver function tests. Rose bengal labeled with iodine-131 proved to be a sensitive method for detecting liver damage. (C.H.)

6204 A/CONF.15/P/1489
EFFECT OF LIPIDS ON RATE OF RADIOACTIVE THYROXINE ELIMINATION. M. S. El-Ridi, A. A. Ismail, A. Abdel-Hay, G. Kamel, and A. Mamoon (Cairo Univ. and Egyptian Atomic Energy Commission, Cairo). 12p.

Thyroxine labeled with phosphorus-32 was used in a study of the effects of lipid administration on the rate of thyroxine assimilation in rats. The effect of dietary lipids on blood cholesterol and their action on thyroxine are discussed. (C.H.)

6205 A/CONF.15/P/1490
THE CLINICAL EXPERIENCE WITH RADIOACTIVE IODINE IN THE TREATMENT OF THYROTOCICOSIS. Ibrahim A. Abou Sinna, Paul Ghalioungi, Saadel Din El Tawdy, Ismail Kazim, and A. M. Gharib (Ein Shams Hospital, Cairo). 14p.

Radioactive iodine has been used for the treatment of selected cases of thyrotoxicosis. 140 patients have been treated during the last two years. The criteria used for selection of case are summarized. In dosage prediction, the factors that were taken into consideration are the estimated gland weight, the predetermined iodine uptake and turnover, the type of the glandular enlargement, and the age of the patients. The total dosage given to the patients varied between 5 to 50 mc. Most of the cases treated with a single dose responded favorably, but some of them required the repetion of the treatment once or more after periods varying from 3 to 6 months. (C.H.)

6206 A/CONF.15/P/1491
THE CLINICAL EXPERIENCE OF PURE BETA RAY APPLICATIONS: RADIOACTIVE STRONTIUM 90, FOR THE TREATMENT OF TRACHOMA IN EGYPT. Ibrahim Ahmed Mohamed, Gamal El Din Abdeen, and Saad El Din El Taoudi (Memorial Inst. for Ophthalmic Research, Giza, Egypt). 11p.

About 50% cures were observed in fifty cases of trachoma in school children treated for about one month with a pure beta-ray strontium-90 applicator. Dosages and application methods are discussed. (C.H.)

6207 A/CONF.15/P/1492
CLINICAL EXPERIENCE WITH A STRONTIUM 90 MEDICAL APPLICATOR IN SOME OPHTHALMIC CONDITIONS. Ibrahim Abou Sinna (Ein Shams Univ., Cairo). 19p.

The general principles, physical and biological properties of beta particles from a strontium-90 applicator are discussed. This applicator is a useful source of beta irradiation which is effective in the treatment of various eye conditions such as corneal vascularization, pterygia, vernal catarrh, tracomatous lesions, and tumors. A summary of the results of treatment of cases over a period of three years in private practice, including the method of treatment and range of dosage, is given. (auth)

6208 A/CONF.15/P/1493
RADIOIODINE STUDIES IN ENDEMIC GOITRE IN THE LIBYAN DESERT. P. Ghalioungui and K. Shawarby (Ain-Shams Univ., Cairo). 11p.

The conversion ratio and the 24-hour iodine-131 uptake were estimated in a number of people from an area where goiter is endemic. The values showed a wide range of variability but correlated well in both tests. Data are interpreted as evidence that the hormonal turnover is rapid in the thyroid glands of people living in endemic areas and that goiter in these regions is due to iodine deficiency. (C.H.)

6209 A/CONF.15/P/1494
AN APPROACH FOR USING LABELLED RADIOACTIVE PHOSPHORUS (P^{32}) IN PHYSIO-PATHOLOGICAL STUDIES OF PLANT-NEMATODE DISEASES. B. A. Otiefa, Y. Barrada, and D. M. El Gindi (Cairo Univ., Giza, Egypt). 12p.

Results are reported from a study of the effect of the rootknot nematode, Meloidgyne javanica, on the nutritional status of one-month old tomato plants. The uptake of phosphorus-32 from nutrient solution by various parts of the plant was measured. (C.H.)

6210 A/CONF.15/P/1495
THE EFFECT OF APPLYING A PHOSPHATE FERTILIZER ON ITS UTILISATION BY THE ASHMOUNI COTTON PLANTS. Y. Barrada, E. El-Bisary, and E. Awadalla (Cairo Univ., Giza, Egypt). 2p.

The effect of the method of phosphorus application in the form of monocalcium phosphate on its utilization by the Ashmouni cotton plants was studied. Phosphate labeled with phosphorus-32 was used in the study. (C.H.)

6211 A/CONF.15/P/1496
EFFECT OF SOIL TEXTURE AND FERTILIZER TREATMENT ON PHOSPHORUS UPTAKE BY HORSE BEANS USING P^{32}. Moustafa Abdel-Samie, M. T. Eid, and S. Hashish (Egyptian Atomic Energy Commission, Cairo). 8p.

A study was conducted to check upon the uptake of phosphorus by horse-beans under different soil texture, i.e., sand, loamy sand, loam, and clay loam soils. Application of phosphate was made at zero, 150 and 300 kilograms P_2O_5 per feddan (4200 sq meters) as superphosphate of lime. All treatments were subjected to one uniform application of nitrogen and potassium to satisfy the maximum requirements. Three weeks after germination, a new application of phosphate solution tagged with the isotope P^{32} at the rate of 50 ml solution in one mc of calcium monophosphate $Ca_2(H_2P^{32}O_4)_2$ were added per pot. The whole arrangement was designed as complete blocks in split pot sets, in two replicates in the green-house. Plants were harvested four days later and weighed for leaves, stems, and roots, and worked on separately by digestion and solution. Counting of the emitted radiation was made by using a Geiger-Müller counter, at uniform conditions. Data were converted to 1000 count per minute per one gram oven-dry plant tissue. Results obtained proved that phosphorus uptake was tremendously high in sandy soil compared with other soil types. At the same time it was shown that the higher the phosphate application, the higher the phosphate uptake as shown by radiation counts. Roots contained the maximum concentration of P^{32} followed by stems, and then by leaves. (auth)

6212 A/CONF.15/P/1499
THE INDUCTION OF MONOSOMICS AND DEFICIENCY-DUPLICATIONS IN GOSSYPIUM HIRSUTUM BY IRRADIATION OF SEED. Mohsin Abbas El Didi (Ministry of Agriculture, Cairo). 2p.

Monosomics and translocation heterozygotes were produced readily in Gossypium hirsutum by exposing germinating seeds to 1200 r of x rays. Data are summarized. (C.H.)

6213 A/CONF.15/P/1500
STUDY ON THE METABOLISM OF BONE-MATRIX

DURING THE HEALING PROCESS OF FRACTURE BY MEANS OF ISOTOPES (Ca^{45}, P^{32}, S^{35}). Isao Aoike and Hideaki Ishigami (Tokyo Medical and Dental Univ.) and Tadahisa Yoneda (First Tokyo National Hospital). 14p.

The healing process was observed by microradioautography following experimentally induced bone fracture in mice. The metabolism of phosphorus-32 labeled nucleic acid, sulfur-35 labeled chondroitin sulfuric acid, and of calcium-45 labeled chondroitin-calcium complex was studied at various times during the healing process. (C.H.)

6214 A/CONF.15/P/1501
APPLICATION OF IODINE-131 IN THYROID DISEASES. Takehiko Tsuchiya, ed. (Tokyo Univ.). 17p.

Applications of iodine-131 in diagnosis and therapy of thyroid diseases are reviewed. (C.H.)

6215 A/CONF.15/P/1502
STUDY ON DIGESTION AND ABSORPTION FOLLOWING GASTROINTESTINAL SURGERIES WITH AN APPLICATION OF RADIOACTIVE ISOTOPES (WITH SPECIAL EMPHASIS ON CASES OF GASTRIC SURGERIES). Komei Nakayama, Atsushi Ohtsuka, Teruo Kuraishi, Masaaki Koshibu, Michio Arima, Michio Fukushima, Tsuneo Nakagami, and Shizuka Fuse (Univ. of Chiba, Japan). 18p.

The digestion and absorption of proteins and fats were studied in patients following radical surgery for carcinoma of the digestive tract. Proteins labeled with phosphorus-32 were synthesized in vivo using goat milk, hen eggs, and intestinal membrane and liver of a dog. Protein labeled with sulfur-35 was obtained from yeast. Amino acid was labeled with carbon-14. Sesame oil labeled with iodine-131 was used as an indicator of fat absorption. The indicators were given orally in test meals. Blood level and fecal and urinary excretion were measured. Procedures are outlined for preparing the labeled indicators. Data are tabulated. (C.H.)

6216 A/CONF.15/P/1506
TECHNIQUE FOR THE USE OF TRITIUM AS A TRACER IN INVIVO BIOLOGICAL SYSTEMS. A. T. Wilson (Dept. of Scientific and Industrial Research, Lower Hutt, N. Z.). 3p.

A technique is described which enables tritium to be used in biological experiments with the same ease as C^{14}. Chromatograms may be run on mixtures of tritium-labelled compounds and radioautographs made to show the location of the individual separated constituents. This technique is applicable in researches into many biological reactions which involve hydrogen. Examples of its use in such researches are given. (C.H.)

6217 A/CONF.15/P/1507
USE OF 15N IN THE STUDY OF FIXATION OF ATMOSPHERIC NITROGEN BY NON-NODULATED SEED PLANTS. Greta Stevenson (Victoria Univ., Wellington, N. Z.). 14p.

Both from observation of non-leguminous plants growing under natural conditions and also from measurements made of plot experiments with grasses it has been found that large amounts of nitrogen, of the order of 50-lb N/acre/year, accumulate both in the soil and in plant material. Measurements of the contribution made by nonsymbiotic nitrogen-fixing bacteria are only of the order of 2 to 3 lb N/acre/year, so that it appears likely that some other mechanism operates which leads to fixation of nitrogen with the growth of many non-leguminous plants. Experiments were carried out with the following species which grow well in New Zealand under poor nutrient conditions, especially as regards nitrogen: Pinus radiata, Coprosma robusta, Epilobium erectum and Dactylis glomerata. Plants have been grown in sand watered with a nitrogen-free nutrient solution when they have shown signs of nitrogen starvation, but, nevertheless, they have made considerable growth. Some plants have been exposed to an isotopically enriched atmosphere for periods of 7 to 14 days, and significant amounts of nitrogen-15 have been recovered from the combined nitrogen in the plants indicating that fixation of molecular nitrogen has occurred. The effect is not due to any of the known nonsymbiotic nitrogen-fixing bacteria which were shown to be absent from the sand cultures. Two possible explanations considered are that the effect may be due to microorganisms present in or on the plants, and that the effect may be due to some activity of the plants themselves. (auth)

6218 A/CONF.15/P/1509
ANTIBIOTIC THERAPY OF ENDOGENOUS AND EXPERIMENTAL INFECTIONS IN X-IRRADIATED MICE. Bent Korner (Statens Seruminstitut, Copenhagen). 14p.

The influence of single sublethal and lethal whole-body x irradiation on autochthonous infections and on infections induced by Salmonella and pneumococci in white mice was investigated. The mice were kept separately in jars under optimal conditions. $LD_{30/30}$ was 560 r. The course of the infection and the radiation syndrome was studied by weight changes, severity of symptoms, mortality rates within 30 days, survival times, bacteriological autopsies and cultures from tailblood, feces and mucous membranes during life. The mice were usually exposed 4 days before or after inoculation, and subcutaneous treatment started one day before or after inoculation. The normal flora of the throat and bowel consisted mostly of a mixture of E. coli and streptococci. The mice were never contaminated with Pseudomonas, Proteus or Salmonella, and neither latent nor overt enzooties occurred. The number of bacteria was reduced by antibiotics but not completely eradicated. Exposure to 550 to 700 r resulted in deaths during the second week after irradiation, sometimes preceded by infections caused by the normal intestinal and respiratory tract inhabitants. Antibiotic treatment, which was usually started 4 days after irradiation, did not reduce the death rate but caused a moderate increase in the survival time. Streptomycin and tetracycline had the greatest effect as they were able to some extent to inhibit bacterial spread and prevent bacteraemia. In mice exposed to 350 r 4 to 5 days before feeding with S. paratyphi B the infection tended to spread from mesenteric lymph gland to spleen. Exposure to 450 r 1 to 7 days before parenteral infection sometimes led to a bacteraemia. Antibiotics provided no protection. (auth)

6219 A/CONF.15/P/1510
GLUCOSE C^{14} IN STUDIES OF THE ACTION OF SULPHONYLUREAS AND INSULIN. F. Tarding and P. Schambye (Novo Terapeutisk Lab. A/S, Copenhagen). 11p.

A single dose of randomly labelled C-14 glucose, representing minute amounts of glucose, was injected intravenously into anaesthetized normal and diabetic dogs in the postabsorptive state. When complete equilibrium was reached the decrease in plasma glucose

activity was determined for a period of about 2 hours. This allowed calculation of the average rate of glucose utilization and the size of the glucose pool. Following this period a dose of either sulphonylurea or insulin was injected intravenously and plasma activities were followed for 3 to 4 hours. The plasma glucose specific activities plotted semi-logarithmically against time demonstrated that the sulphonylureas produced initially a cessation of the dilution of the glucose activity for a period of about 40 minutes after the injection. This was presumably caused by a block in the release of the glucose from the liver. A considerably longer lasting block was observed in a pancreatectomized diabetic dog deprived of insulin for a period of 18 hours and which consequently showed a pronounced decrease in the blood-glucose concentrations. Similar observations were made in collaboration with others in studies of the action of sulphonylureas in diabetic patients. Physiological doses of insulin, on the other hand, produced a sharp increase in the rate of dilution of the plasma activities corresponding to an increase in the glucose release from the liver. However, when considerably higher doses of insulin were administered a short-lasting block in the glucose output of the liver could be observed. (auth)

6220 A/CONF.15/P/1512
THE LIFE CYCLE OF HEN ERYTHROCYTES DETERMINED BY LABELLING WITH RADIOACTIVE PHOSPHORUS. J. Ottesen (Copenhagen Univ.). 4p.

When radioactive phosphorus is injected into a hen the isotope is incorporated in the red cell deoxyribo nucleic acid (DNA) during the DNA formation only, prior to mitosis. One day after the injection the red cell DNA in the blood stream is inactive, thus indicating the metabolic stability of the DNA in the mature cells. A few days later, the labelled cells appear in the blood stream. This lag is interpreted as the time of maturation which the cells spend in the bone marrow. About 30 days later a precipitous fall in the specific activity of the DNA in the blood stream indicates that the strongly radioactive cells which were formed during the first days after the injection terminates their lifespan and disappears from the blood stream. The average time the red cells spend in the blood stream is 30.5 days. (auth)

6221 A/CONF.15/P/1528
EXPERIMENTAL IONTOPHORESIS WITH RADIOISOTOPES. I. CONCENTRATION GRADIENT. V. H. Gonzalez-Panizza, U. Gelos, and M. A. Patetta-Queirolo (Montevideo Medical School). 8p.

(Part II issued as A/CONF.15/P/1529.)

The authors have investigated the distribution of P^{32} tagged sodium orthophosphate in the tissues of the lower limb of the toad (Bufo arenarum H.), following its penetration by iontophoresis, as induced by a longitudinal electrical field of given intensity and duration. Curves showing the variation in the relative concentration along the electrical field were drawn, as a function of the distance to the negative pole, in cutaneous, muscular and bony tissues. The blood levels of the tagged phosphate were measured, and determinations were made in the distally located tissues in order to obtain an index of the degree of focal dispersion; cutaneous permeability monitors also were designed, with similar devices, but no direct current was circulated. From a series of eight experiments it was concluded that there is a concentration gradient for the tagged phosphate along the electrical field, which decreases from a maximum, close to the negative pole, to a minimum at a distance of 5 to 6 cm from said pole. The gradients, in the three tissues analyzed, seem to be identical. The ion introduced into the animal is not confined to the interelectrode space. It penetrates the systemic circulation, and concentrations lower than 10% of the least ones recorded in the areas treated can be measured in the blood. (auth)

6222 A/CONF.15/P/1529
IONTOFORESIS EXPERIMENTAL CON RADIOISOTOPOS. II. CONDUCCIÓN IÓNICA POR CADA TEJIDO. (Experimental Iontophoresis with Radio-Isotopes. II. Ionic Conduction in Each Tissue). U. Gelós, V. H. González Panizza, and M. A. Patetta Queirolo (Montevideo Medical School). 4p.

(Part I issued as A/CONF.15/P/1528.)

A series of experiments were made to determine the degree of ion conduction in each individual tissue (skin, muscle, and bone). In the preparation, two of the tissues were removed and the third was left in situ. Radioactivity determinations were made in distantly located tissues and in the blood. It was found that the distribution gradients for the three tissues were different. Bone does not behave as a conductor of the labeled ion. Skin has the most pronounced gradient, and muscle tissue has the highest ion conduction. Muscular conduction appears to be the basic reason for the penetration of the ion into the blood. (J.S.R.)

6223 A/CONF.15/P/1531
THE SIGNIFICANCE OF THE CAPTURE CURVES IN THE STUDY OF THYROID DYSFUNCTION. Jorge A. Traibel and Walter S. Hill (Univ. of Uruguay, Montevideo). 17p.

Results are described which were obtained using a special type of collimation and moving the counter along the axis of the body of a patient, who had previously ingested a tracer dose of I^{131}. With the help of this diagnostic technique, it is possible to arrive at a better knowledge of the iodine metabolism in each individual case, provided the study be repeated at suitable intervals, which can be done allowing for the speed with which it can be carried out and the simplicity of the technique. Data are included on radioiodine uptake in patients with various types of thyroid diseases. (C.H.)

6224 A/CONF.15/P/1532
EXOGENOUS IODINE AS A FACTOR OF INTERFERENCE IN RADIO-IODINE THYROID TESTS. Jorge A. Traibel and Walter S. Hill (Univ. of Uruguay, Montevideo). 5p.

A systematic study was made of the action of previous iodine administration on the results of iodine-131 thyroid function tests in 121 subjects. Data are presented graphically on the capture rates by hyper and euthyroid patients previously treated with inorganic iodine or subjected to a cholecystogram. Implications of the findings in radioiodine treatment of thyroid diseases are discussed. (C.H.)

6225 A/CONF.15/P/1563
THE FUNCTION OF THE CITRIC ACID CYCLE IN SACCHAROMYCES CEREVISIAE. A. O. M. Stoppani, Susana L. S. de Favelukes, Lucia Conches, Eugenia Ramos, and M. Martha Pigretti (Comisión Nacional de Energía Atómica, Buenos Aires and Univ. of Buenos Aires). 30p.

The role of the citric acid cycle in yeast was investigated. Suspensions of fasting Saccharomyces cerevisiae were incubated with carbon-14 bicarbonate and substrates in a closed vessel connected with a volume compensator, and simultaneous measurements of the oxygen consumption were made under equal experimental conditions. (C.H.)

6226 A/CONF.15/P/1575
RAPID METHOD FOR OBTAINING COLLOIDAL SUSPENSIONS OF P^{32} AS CHROMIC PHOSPHATE.
Leopoldo José Anghileri (Comisión Nacional de Energía Atómica, Buenos Aires). 7p.

A rapid and simple method is described for the preparation of colloidal suspensions of chromic phosphate containing P^{32}. The P^{32} yield is increased from 25 to 75% due to the shorter preparation time. It is based on a reduction–oxidation reaction involving chromic acid, phosphoric acid, and a reducing agent and subsequent precipitation, washing, and redissolving in isotonic disodium phosphate solution. (W.D.M.)

6227 A/CONF.15/P/1586
THE EFFECT OF IONIZING RADIATION (X-RAYS) ON δ-AMINOLAEVULIC ACID DEHYDRASE. A. M. Dancewicz and B. Lipinski (Polish Academy of Sciences, Warsaw). 11p.

Studies are reported on the effects of radiation on the biosynthesis of heme and the causative factor in anemia associated with radiation sickness. Data are presented from the results of studies on the effects of x radiation on enzyme systems which catalyze the synthesis of porphobilinogen, the precursor of porphyrin and heme. (C.H.)

6228 A/CONF.15/P/1588
APPLICATION OF RADIOISOTOPES TO THE QUANTITATIVE CHROMATOGRAPHY OF FATTY ACIDS.
A. Z. Budzyński, Z. J. Zubrzycki, and I. G. Campbell (Polish Academy of Sciences, Warsaw). 23p.

The paper reports work done on the use of I^{131}, Zn^{65}, Sr^{90}, Zr^{95}, Ce^{144} for the quantitative estimation of fatty acids on paper chromatograms, and for determination of the degree of unsaturation of components of resolved fatty acid mixtures. I^{131} is used to iodinate unsaturated fatty acids, and the amount of such acids is determined from the radiochromatogram. The degree of unsaturation of fatty acids is determined by estimation of the specific activity of spots. The other isotopes have been examined from the point of view of their suitability for estimation of total amounts of fatty acids by formation of insoluble radioactive soaps held on the chromatogram. In particular, work is reported on the quantitative estimation of saturated fatty acids by measurement of the activity of their insoluble soaps with radioactive metals. Various quantitative relationships are described between amount of fatty acid in spot and such parameters as radiometrically estimated spot length, width, maximum intensity, and integrated spot activity. A convenient detection apparatus for taking radiochromatograms is also described. In conjunction with conventional chromatographic methods for resolving fatty acids the method permits the estimation of composition of fatty acid mixtures obtained from biological material. (auth)

6229 A/CONF.15/P/1592
APPLICATIONS OF RADIOACTIVE INDICATORS TO QUANTITATIVE STAINING REACTIONS. D. Shugar (Polish Academy of Sciences and State Inst. of Hygiene, Warsaw). 32p.

A brief outline is presented of the principles and practice of quantitative staining techniques for biological materials and the application of labelled substances for this purpose, quantitative results being obtained by end-window counting or autoradiography of the stained preparations mounted on slides. Work initiated in this field during the past year has included the application of I^{131}-labelled lugol and C^{14}-labelled crystal violet to gram staining of microörganisms and extracellular material, the use of C^{14}-labelled triphenylmethane dyes and S^{35}-labelled thiazine dyes to acid-fast staining, and the application of a variety of different indicators to the quantitative histochemistry of alkaline and acid phosphatases. The techniques developed have also made it possible to study the mechanisms of the staining reactions, as well as to investigate quantitatively the validity of some of the techniques used in histochemical staining procedures. The preparation of labelled dyes makes available a useful tool for studying the kinetics of staining, replacement of one dye by another, and measurements of dye uptake and retention. In the field of histochemistry it now becomes possible to follow enzyme kinetics on single sections by the use of appropriately labelled substances. A short account is included of work still in progress in order to better illustrate the theoretical and practical applications of these techniques. (auth)

6230 A/CONF.15/P/1602
ETUDE ANALYTIQUE DES TUBERCULES DE POMMES DE TERRE SOUMIS AUX RADIATIONS NUCLEAIRES. (Effects of Irradiation by Gamma Rays on Potatoes Tubers.) (Défense Nationale, Paris and Société Conservatome, Lyon). 8p.

A study was made of the radiation effects of gamma doses between 100 and 50,000 rads on potato tubers. The results were evaluated with respect to preservation of the potato and possible modifications in the cellular structure and distribution of glucidic reserves. The results showed that doses lower than 1,000 rads had no inhibitory effects, but rather appeared to have a stimulating effect. Above 1,000 rads the germination is inhibited, and above 5,000 rads the tubers germinate in a very slow manner. The optimum dose to apply to tubers for preservation appears to be between 7,500 and 8,000 rads. Tubers irradiated above 5,000 rads display significant morphological changes analogous to those observed when the young vegetables are seared by solar radiation. The study of the effects of radiation on the amino acids and vitamin C of potatoes shows that the amino acids are affected only to a slight degree which is of the same order as that found in cooking. The rate of destruction of vitamin C is proportional to the dose received. (J.S.R.)

6231 A/CONF.15/P/1603
UPTAKE AND TRANSLOCATION OF 3-AMINO- AND 3-HYDROXY-1,2,4,–TRIAZOLE IN PLANTS.
P. Massini (N. V. Philips' Gloeilampenfabrieken, Eindhoven, Netherlands). 9p.

The uptake and translocation of radioactive 3-amino- and 3-hydroxy-1,2,4-triazole in various plants were investigated. The first compound is taken up and translocated much faster than the second one upon administration to a leaf. The rate of uptake through the roots or through the cut-off stem is the same for the

two compounds. The distribution of aminotriazole in the plants points to a translocation by the phloem system. (auth)

6232 A/CONF.15/P/1622
RADIATION THYROIDITIS AFTER TREATMENT WITH RADIOACTIVE IODINE (I^{131})—CLINICAL AND LABORATORY INVESTIGATIONS. P. Czerniak and A. Harell-Steinberg (Tel-Hashomer Government Hospital, Israel). 18p.

Beta and gamma rays from I^{131} may cause radiation thyroiditis, which presents the pathological picture of a subacute thyroiditis. The cases of 21 patients have been studied who have been treated with I^{131} (14 cases of hyper-thyroidism and 7 cases of angina pectoris, mostly with normal thyroid function). Laboratory findings are summarized. Clinically, radiation thyroiditis is accompanied by mild complications, such as pressure, dyspnoea, cramps, and irritability, and serious ones, such as cor pulmonale, pseudo-oedema pulmonum, and temporary cardiac arythmia. In 4 cases of angina pectoris treated with I^{131}, it was noted that the requirement for nitroglycerin rose slightly. From a correlation of these observations and the histopathological changes, it is concluded that clinically evident radiation thyroiditis is caused only by doses larger than 10,000 rep/g thyroid tissue. The severity of the symptoms is not always proportional to the dose given. The severity of the complications depends on the amount of radioactive iodine absorbed, the biological half-life of the I^{131}, and the size of the thyroid. The complications appear to be more severe in cardiac patients. (C.H.)

6233 A/CONF.15/P/1623
RADIOACTIVE STRONTIUM 90 IN THE TREATMENT OF CYSTIC GLANDULAR HYPERPLASIA OF THE ENDOMETRIUM. P. Czerniak, E. Rabau, and K. Rikower (Tel-Hashomer Government Hospital, Israel). 13p.

Ten patients with cystic glandular hyperplasia were treated by introducing 2 or 3 applicators containing Sr^{90} tubes (60 to 90 mc) into the uterine cavity for 7 to 10 hours (560 to 850 mc). The results of the treatment were satisfactory. In most of the cases hemorrhages ceased after one month; in two cases the treatment had to be repeated. In one case the treatment failed and at hysterectomy large myomata were found. A histological study was made of the cases for periods up to one year. It was concluded that the Sr^{90} treatment does no somatic or genetic damage to the ovaries and therefore is suitable also for young patients. Satisfactory results can be expected if proper indication exists and the dosage is well adjusted. (C.H.)

6234 A/CONF.15/P/1644
EVALUATION OF A NEW APPROACH TO CHEMOTHERAPY OF CANCER USING RADIOACTIVE ISOTOPE TRACER TECHNIQUE. M. V. Narurkar, M. K. Nerurkar, and M. B. Sahasrabudhe (Atomic Energy Establishment, Trombay, India) and B. D. Tilak (University Dept. of Chemical Technology, Bombay). 4p.

The search for qualitative differences between tumor tissue and their normal counterpart has so far been unsuccessful. Instances of quantitative differences between the two are many. For example, evidence has been put forth to suggest that most tumors derive their energy via the 6-phosphogluconate oxidative (or HMP) pathway. Since this pathway is present to a lesser extent in normal tissue, any interference with it will preferentially act on tumor tissue. Because of this a number of substances are being tried as anticancer agents. In addition to studying the anticancer properties of various tumors, their effectiveness in interfering with the HMP oxidative pathway is also being tested with glucose-1-C^{14} and glucose-6-C^{14}. Here advantage is taken of the fact that whereas the radioactivity of glucose-1-C^{14} appears in CO_2 via both the EM and HMP pathways, that from glucose-6-C^{14} appears only via the EM pathway. The tracer technique will not only give an indication of the interference with the energy production of the tumor but it will also tell us which of the tumors are likely to respond to this approach of chemotherapy of cancer. (auth)

6235 A/CONF.15/P/1646
CYTOCHEMICAL STUDIES OF NUCLEAR METABOLISM IN BIOLOGICAL SYSTEMS. A. R. Gopal-Ahengar (Atomic Energy Establishment, Trombay, India). 6p.

With the aid of track autoradiography using an electron sensitive liquid emulsion it was possible to follow the intracellular incorporation of a labelled precursor like adenine-8-C^{14} which is specific for nucleic acids. The incorporation was determined on the basis of the topographical emission of ionizing particles in particular oganelles of the cell. The balance of evidence points to the fact that in oocytes of the newt, the nucleolus incorporates adenine with marked rapidity in the RNA. However, the fact that there is a high specific radioactivity in the nucleolus does not necessarily imply that the site of synthesis of RNA is centered in this intranuclear structure, since in the actively dividing mersystematic cells of Vicia faba there is a preferential uptake of the labelled adenine in the heterochromatic and nucleolar organizing (SAT) regions of the long chromosomes. From this it would appear that the nucleolus acts as a reservoir of RNA and that actual synthesis supervenes in the heterochromatic regions and SAT-loci of particular chromosomes. In an attempt to understand the mechanics of chromosome replication, cytologists have made many assumptions, the validity of which has not been tested on cytochemical grounds until very recently. Although it has been known for long that during mitosis there is a doubling of chromosomes followed by an equipartition of chromosomal substance between the two daughter nuclei, no decisive technique has so far demonstrated whether the original chromosome produces by a self-duplicating process a replica of itself from available new material or whether the original chromosomal substance is equally distributed between the daughter nuclei. However, with the availability of specific precursors, like thymidine-2-C^{14} of DNA and refinement in autoradiographic techniques it is now possible to selectively label particular components of chromosomes and follow the fate of the tagged atoms in successive mitotic cycles. In this way evidence is accumulating to suggest the operation of a template process in chromosome synthesis and duplication, at any rate in the somatic mitoses of Vicia faba and Luzula species. The cytological implications of such a synthesis are further discussed. (C.H.)

6236 A/CONF.15/P/1648
EXPERIENCE WITH RICE (ORYZA SATIVE) ON THE INDUCTION OF MUTATION BY IONIZING RADIATIONS. I. INDUCTION OF EARLY FLOWERING AND AWNED MUTANTS BY X-RAYS AND THERMAL NEUTRONS. K. C. Bora and N. S. Rao (Atomic Energy Establishment, Trombay, India). 17p.

Experiments were carried out on the induction of mutations in rice following exposure of dry seed. Experiments were carried out with 30 varieties of rice grown in various parts of India. An attempt was made to correlate mutations with observed chromosomal changes such as duplications and deficiencies. (C.H.)

6237 A/CONF.15/P/1651

COMPARATIVE EFFECTS OF VARYING DOSES OF X-RAYS AND FAST NEUTRONS OF THE GROWTH AND DEVELOPMENT AND INDUCTION OF CYTOLOGICAL CHANGES IN TETRAPLOID AND HEXAPLOID WHEAT. K. C. Bora (Atomic Energy Establishment, Trombay, India). 18p.

Experiments have shown that while the tetraploid wheat, Jaya 808 (4n = 28), requires about 25,000 r of 220 kvp x rays for reducing fertility of spikelets to 50%, the hexaploid variety Kemphad (6n = 42) requires about 40,000 r without causing appreciable reduction in the vigor of growth and serious developmental irregularities. Meiotic studies on the X_1 plants have revealed that one of the striking irregularities is the quite high frequency of unoriented univalent chromosomes at metaphase and anaphase of the first meiotic division. For instance, in Kemphad the frequency of such univalents is 306.71 per 100 pollen mother cells against 37.75 in the control; in Jaya it is 25.90 against nil in the control. It has been observed that as far as the chromosomal aberrations are concerned the hexaploid is less radioresistant than the tetraploid. The evidence on the effect on the growth and development processes suggests that at certain dosage levels factors other than chromosomal damage may become more harmful. Experiments on the relative biological efficiencies of 220 kvp x rays and fast neutrons on the induction of various types of aberration in the resting stage chromosomes of dry wheat grains were carried out to ascertain the appropriate fast neutron doses for future experiments. The flux of fast neutrons was 10^{10} sec/cm^2. The seeds were exposed for 2, 4, 8 and 16 minutes. The RBE value has been found to vary at different dosage levels and with different types of aberration. It has, however, been determined that the most appropriate RBE value of fast neutrons for inducing di-, tri- and multicentric chromosomes would be about 9. It has further been observed that high doses of fast neutrons induce a large number of chromatid aberrations in the dry seeds. This finding is unexpected, and calls for reconsidering the hypotheses on the mechanism of induction of chromosomal aberrations by ionizing radiations. (auth)

6238 A/CONF.15/P/1652

RELATIVE BIOLOGICAL EFFICIENCIES OF 220 kVp X-RAYS AND 14.1 MeV FAST NEUTRONS ON THE INDUCTION OF ABERRATIONS IN THE CHROMOSOMES OF TRADESCANTIA AT LOW TEMPERATURES. K. C. Bora (Atomic Energy Establishment, Trombay, India). 16p.

Interphase chromosomes of the microspores of Tradescantia paludosa were irradiated at 22 ± 1°C and 2.5 ± 0.5°C with 220 kvp x rays and monoenergetic 14.1 Mev fast neutrons. The dosage range employed was 100 to 600 roentgens for x ray and 50 to 600 rads for fast neutrons. While the dosage rate of x rays from a Maxitron machine operating at 220 kv, 15 ma with an added filter of 4 mm Cu was 20 r per minute that of fast neutrons, obtained from the nuclear reaction T (d,n) He^4 at the tritium target in the 250 kv Cockcroft-Walton accelerator of the Biology Division, Oak Ridge National Laboratory varied from 15.5 to 26.9 rads per minute. The fast neutrons were accompanied by a small contamination of gamma rays. The irradiated chromosomes were fixed 72 hours after irradiation and the polar view metaphases were analyzed for chromosome dicentrics, tricentrics, quadri and pentacentrics, acentric and centric chromosome rings, simple chromosome breaks and minutes. The number of microspores scored from each treatment varied from 200 to 500. The results indicate that like oxygen low temperature may have an appreciable effect in altering the RBE values, especially when the chromosomal aberrations are the biological effects examined. The RBE values for fast neutrons at 22 ± 1°C for all types of chromosomal aberration and microspore damage ranged from 2.0 to 2.5. There is a substantial difference between the values of RBE for chromosome reunions and chromosome deletions. The lowest value of RBE has been shown by the microspore damage. The corresponding range of RBE values for fast neutrons at 2.5 ± 0.5°C has been found to be 2.9 to 4.3. Here again, a considerable difference has been observed between the RBE values for chromosome reunions and minute deletions. Microspore damage has shown the lowest RBE value i.e., about 2.9. It has further been observed that the RBE value may be dependent on the dose of radiation. There is evidence to suggest that it tends to decrease when the dosage level passes a critical maximum and proceeds to a state of saturation where a considerable amount of energy is wasted and the processes of reunion, restitution and healing of broken chromosome ends are very much disturbed. For instance while the RBE value of fast neutrons in inducing chromosome reunions of all types at 2.5 ± 0.5°C is about 2 when the dosage is in the region of 600 rads it is about 4 when the dosage level is reduced to about 150 rads. It is suggested that there may be a fundamental difference in the action of these two radiations at low and high temperatures. (auth)

6239 A/CONF.15/P/1653

FACTORS AFFECTING THE RELATIVE BIOLOGICAL EFFICIENCIES OF IONIZING RADIATIONS. K. C. Bora (Atomic Energy Establishment, Trombay, India). 30p.

A survey is presented of the available RBE data, both on plants and animals, and all the important and known biological effects studied so far. It is suggested that while assessing the relative biological hazards of ionizing radiations on the human population in general and calculating the maximum permissible dose, the effects of various factors influencing the efficiency of an irradiation should be most carefully analyzed and critically examined. (auth)

6240 A/CONF.15/P/1655

MODIFICATION OF IRRADIATION INJURY BY METHIONINE. M. B. Sahasrabudhe (Atomic Energy Establishment, Trombay, India). 16p.

Extensive work has been carried out in this laboratory on the radiolability of methionine and its role in radiation injury. Using $C^{14}H_3$ and S^{35} labelled methionine it was shown that the methyl group is easily dislodged as a result of irradiation. Methionine is an active methyl donor and in view of its extreme radiolability, effects of radiation on the levels of DNA in bone marrow, spleen, and liver, levels of creatine phosphate in muscle and the excretion of creatine, creatinine, and N-methyl nicotinamide in urine were investigated in rats.

Administration of methionine half an hour after irradiation was shown to reverse the radiation effects on DNA levels in bone marrow and spleen and the excretion of creatine and N-methyl nicotinamide in urine. Beneficial effects of single injection of methionine half an hour after irradiation on the blood picture of irradiated animals, their growth rates, and the excretion of urea, uric acid, and nitrogen in urine was also investigated. Two alternative mechanisms of action appear possible, either the post irradiation administration of methionine merely replaces the depleted methyl donors in the metabolic pool of irradiated animals, or the methionine repairs the damaged oxidative phosphorylation. These were investigated by studying the incorporation of $C^{14}H_3$ group of methionine-$C^{14}H_3$ in some of the important methylated compounds in the body and the influence of methionine on the oxidative phosphorylation of the mitochondrial system isolated from irradiated animals. (auth)

6241 A/CONF.15/P/1657

IN VITRO RADIOLABILITY OF HAEMOGLOBIN. N. S. Ranadive and M. B. Sahasrabudhe (Atomic Energy Establishment, Trombay, India). 9p.

One of the symptoms of acute radiation sickness is protein shock. Since hemoglobin is widely distributed in the body it was necessary to know the radiolability of hemoglobin and its role, if any, in induction of protein shock in irradiated animals. Denaturation of hemoglobin as a result of irradiation has therefore been investigated. Since radiation effects are mediated through oxidizing radicals, methemoglobin formation and oxidation of the conjugated double bond system in the porphyrin ring were also anticipated. Aqueous solutions of adult human hemoglobin were therefore irradiated with β-γ radiations from radon sources and G values determined. G values for oxidation of the conjugated double bond system of the porphyrin ring, methemoglobin formation and denaturation were found to be 0.0326, 0.0098, and 0.016 respectively. It has been shown that treatment with dilute acids of the irradiated hemoglobin results in the liberation and opening of the porphyrin ring into a straight chain biliverdin-like compound. (auth)

6242 A/CONF.15/P/1684

LA LESION RADIOLOGIQUE ET SA RESTAURATION DANS L'OVAIRE DE LAPINE: ETUDE ANALYTIQUE. (An Analytical Study of Radiological Lesions in the Rabbit Ovary and Recovery from them). P. Desaive and D. J. Mewissen (Univ. of Liège). 8p.

An analytical study was made of the recovery from radiological lesions in the irradiated ovary of the rabbit. The destruction of the follicles was measured accurately by a counting method on a series of cross sections. Primordial follicle counts were made on 146 rabbit ovaries following local irradiation by a single dose of 2,500 r, a single dose of 1,050 r, or a total dose of 1,050 r in five equal fractions at intervals of 48 hr. A statistical analysis of the results showed that recovery was of the exponential type. The recovery rate was inversely proportional to the radiation dose. (J.S.R.)

6243 A/CONF.15/P/1686

HIBERNATION ET RADIORESISTANCE. (Hibernation and Radioresistance). E. E. Godfroi (Centre d'Etude de l'Energie Nucléaire, Brussels). 12p.

The effect of hibernation on the radioresistance of the adult albino rat was studied. Hibernation increases the resistance of the rat submitted to a LD_{100} irradiation by gamma rays and thermal neutrons. The rats were hibernated by the Cahn and Baclesse method and the rectal temperature was lowered to 20°C. They were then irradiated in a reactor with 1000 r. It was shown that the increase of radioresistance was caused by the hibernation and not by the drugs injected. The protective effect of cysteine is also increased by hibernation. However, an injection of pentothal plus hibernation and cysteine or pentothal and cysteine alone give a toxic complex at doses which are, if the products are individually injected, not toxic at all. (auth)

6244 A/CONF.15/P/1694

DEGATS RADIOACTIFS INFLIGES A L'ALBUMINE EN PRESENCE D'AGENTS PROTECTEURS PAR LES NEUTRONS THERMIQUES ET LES RAYONS GAMMA. (Radiation Damage of Albumen and Serum in the Presence of Protective Agents by Thermal Neutrons and γ-Rays.) A. Heyndrickx and F. Schauvliege (Univ. of Ghent and Centre d'Etude Nucléaire, Mol, Belgium). 10p.

The levels of sulfhydryl (-SH) and disulfide (-S-S-) in albumin were measured and their variation from thermal neutron and gamma radiation in the presence of protective agents such as cysteine, cystine, cysteinamine, and cystamine was studied. Albumin and blood serum were exposed to radiation with and without the addition of protective agents and with and without the presence of air. The -SH and -S-S- content was measured. The formation of complex and degradation compounds was examined by polarographic techniques. A mechanism for the reaction of the sulfhydryl and disulfide compounds during irradiation is proposed. It is shown that the more stable the final product, the more resistant the albumin will be to radiation damage. (J.S.R.)

6245 A/CONF.15/P/1695

RELATIONS NUCLEOCYTOPLASMIQUES AU COURS DE L'EFFET DU RAYONNEMENT SUR LES CELLULES VIVANTES. (Nucleocytoplasmic Relationships during the Action of Radiation on Live Cells.) M. Errera, A. Ficq, R. Logan, Y. Skreb, and F. Vanderhaeghe (Univ. of Brussels). 8p.

Some of the biological and biochemical effects of radiation can be investigated on parts of cells isolated prior to exposure. Studies were made on isolated nuclei of thymocytes or nuclei combined with cytoplasmic fractions of hepatic cells and on isolated cytoplasm or cytoplasm in the presence of a nucleus from amoeba and Acetabularia mediterranea. The isolated nuclei of the thymus and liver cells is sensitive to radiation with the metabolism of its proteins and nucleic acids much reduced. The anuclear fragments of the amoeba survive for a shorter time than the nucleated sections when subjected to identical doses of ultraviolet light. Irradiation by x and ultraviolet radiation affects the survival of both nucleated and anuclear fragments of Acetabularia. (J.S.R.)

6246 A/CONF.15/P/1696

INFLUENCE DES MODALITES D'IRRADIATION SUR L'INCIDENCE DES RADIO-LEUCEMIES. (Influence of the Amount of Irradiation on the Incidence of Radio-Leukemia.) D. J. Mewissen (Oak Ridge Inst. of Nuclear Studies, Inc., Tenn. and Univ. of Liège). 9p.

The effects of some circumstances of fractionation and protraction on the incidence of lymphosarcomas in

mice exposed to different doses of gamma radiation were studied. The effect of chemical protection with cysteamine or cystamine on these factors was also investigated. In two series of experiments the animals received 301, 406, 550, or 742 r in two fractions five days apart. In the first series the animals were given an intraperitoneal injection of cysteamine or cystamine before each irradiation. In the second series the animals received cysteamine orally. In a third series the animals received a total dose of 640 r in four fractions at intervals of seven days with an intraperitoneal injection of cysteamine before each irradiation. In the fourth series the animals were treated as in the third series, but they also received streptomycin in the drinking water. The number of tumors in the animals surviving the irradiation was determined. The results are tabulated. The incidence of tumors increases with the total irradiation dose received. At equal doses, the carcinogenic effect of a fractionated irradiation is greater than that of a single dose. The chemical protection does not modify the carcinogenic effect of radiation in the same manner as its lethal effect. Cysteamine and cystamine are not carcinogenic agents. (J.S.R.)

6247 A/CONF.15/P/1697

LEUCOPENIE, NEUTROPENIE ET BACTERIEMIE CHEZ LA SOURIS, APRES DEUX IRRADIATIONS SUCCESSIVES PAR RAYONS X. (Leukopenia, Neutropenia and Bacteremia in Mouse Following Two Successive Irradiations by X-Rays.) D. J. Mewissen, E. H. Betz, M. Betz-Bareau, and G. A. Duchesne (Univ. of Liège). 11p.

A study was made of the course of leukopenia, neutropenia, and bacteremia in mice subjected to whole body x radiation to determine a possible correlation b tween their variations and the bimodal nature of the lethal response. The mice, five days apart, were subjected to two whole-body x irradiations of 220 r each. The mice were sacrificed at intervals of 9, 12, 14, 19, 29, and 40 days after the first exposure. Spleen and cardiac blood examinations were made on each mouse. The results showed that the percentage of animals in which the leukopenia was marked passed through maxima near the 12th day and the 22nd day. The maxima coincide in time with the highest mortality rates observed in irradiated mice. The neutropenia goes through two critical minima which are essentially contemporaneous with these rates. A bacteremia was observed only in the vicinity of the first maximum in the mortality rate. (J.S.R.)

6248 A/CONF.15/P/1698

MECHANISME DE LA RADIO-RESISTANCE RELATIVE PROVOQUEE PAR UNE IRRADIATION TOTALE A DOSES SUBLETALES. (The Mechanism of Relative Radio-Resistance as Brought About by Sublethal Doses of Whole Body Irradiation.) E. H. Betz, P. Lelievre, and G. Booz (Univ. of Liège). 11p.

It has been shown that mice submitted to a whole-body irradiation of a sublethal dose become more resistance to a subsequent lethal dose of radiation. The possible relation of the hematopoietic tissue to this radiation resistance was investigated. Three lots of mice were irradiated; the first lot received 500 r, the second lot, 725 r, and the third lot, 500 r followed after 15 days by a second dose of 725 r. The 500 r radiation caused extensive destruction of the lymphoid and myeloid tissues. There was 100% mortality in the mice receiving 725 r. In the mice which received the two radiation doses, a large proportion of the lymphoid and myeloid cells escaped destruction and there was rapid recovery from the lesions. A second series of experiments confirmed the relative radioresistance of the lymphoid cells and thymocytes undergoing regeneration. It was shown that there are no essential differences in the metabolic activities of regenerating hematopoietic cells and normal cells. The radioresistance of the hematopoietic cells is not evident when the cells are irradiated in vitro. These results suggest the hypothesis that the radioresistance is caused by a modification in the environmental conditions which prevail within the tissues undergoing regeneration. (J.S.R.)

6249 A/CONF.15/P/1706

POLYPLOIDY, RADIOSENSITIVITY AND MUTATION FREQUENCY IN WHEATS. A. T. Natarajan, S. M. Sikka, and M. S. Swaminathan (Indian Agricultural Research Inst., New Delhi). 25p.

Three varieties of wheat were treated with different dosages of x rays, beta particles from P^{32} and S^{35}, and fast and thermal neutrons to ascertain the effects of polyploidy on sensitivity to these radiations. Dry seeds or seeds with 21% moisture content were treated, and observations were recorded in X_1, X_2, and X_3 progenies. The percentage of survival increased with an increase in chromosome number. Pre-soaking in water led to an increase in mortality as compared to the irradiation of dry seeds up to a dosage of 22,000 r of x rays, but beyond this dosage pre-soaking increased the survival percentage. The development of several improved varieties of bread wheat is reported. Applications of the findings in plant breeding programs are discussed. (C.H.)

6250 A/CONF.15/P/1713

APPLICATION OF RADIOACTIVE ISOTOPES IN RESEARCHES OF AGROCHEMISTRY AND SOIL SCIENCE IN HUNGARY. Janos di Gleria (Agrochemical Research Inst., Budapest). 18p.

Kinetics of adsorption of phosphorus was studied in a given soil. It was shown by the studies that the adsorption of phosphorus is a very complicated process combining several simultaneous reactions, involving adsorption, ion exchange and isotope exchange. To separate the individual parts of the process we investigated the changes in the P^{32}/P^{31} relation during the above mentioned procedures and the changes of pH as well. The investigations were carried out in light different concentration series. The C^{14} labelled organic or inorganic carbon compounds present in the nutrient solution which can be most easily utilized by the plant were also studied. Changes in time of the uptake were recorded, and studies were made to determine the adsorption occurring on the surface of the root. Field experiments were carried out to clear the question of the effect of compounds containing different doses of P^{32} on the dynamics of plant-growth and on the yield of crops. It is to be supposed that the microörganisms of soil support the nutrition of plants by their work furnishing nutritive materials from beyond the rhisosphere. Applying the kinetical isotopic method we succeeded in determining that this fact is true and that the bacteria, building a chain of transport, really take part in the nutritive supply of plants. Applying labelled Ca compounds the effects of fertilizers containing Ca on sodic soils were studied. The effects of the fertilizers on soils were also studied. Using phosphorus-32, the behavior of four phosphorus fractions was studied in

plants grown on sandy soil during the whole season. The phosphorus content of the nucleic acid was very striking in young tissues, in older tissues it was observed to decrease with the proteinphosphorus. In the course of further investigations we studied the incorporation of phosphorus acquired from the nutritive materials into the individual organisms of the plant and in the phosphorus fractions respectively with the help of P^{32}. (auth)

6251 A/CONF.15/P/1723
FORMATION OF LABELLED PROTEIN PRECURSOR IN TISSUE SLICES DURING THE COURSE OF BIOSYNTHESIS OF AMYLASE. F. B. Straub, T. Garzó, and Á. Ullmann (Medical Univ., Budapest). 8p.

Aerobically incubated pigeon pancreas tissue slices were labelled with glycine-1-C^{14}. After different periods of incubation the radioactivity of the total proteins and that of the amylase isolated from the slices were determined. (C.H.)

6252 A/CONF.15/P/1724
ION EXCHANGE IN MUSCLE AND NERVE ACTIVITY. E. Ernst, J. Tigyi, and A. Niedetzky (Univ. of Pécs, Hungary). 3p.

Ringer solution containing potassium-42, sodium-24, or phosphorus-32 was used in studies of ion exchange in isolated frog muscles and nerves. Basic phenomena of physiological excitation are discussed. (C.H.)

6253 A/CONF.15/P/1728
QUELQUES DONNÉES SUR LE PROBLEME DE LA DISPARITION ET MOBILISATION DES GRANULOCYTES. (Some Data to the Disappearance and Mobilization of Granulocytes). Paul Kertai (Université de Médecine, Budapest). 7p.

Histological, chemical, and isotopic methods were used to determine the location and history of leukocytes disappearing during leukopenia, as well as their relation to the white blood cells circulating during leukocytosis. P^{32}-labeled leukocytes were administered to white rats and rabbits and the course of the leukocytes followed. The results led to the conclusion that during leukopenia the major parts of the leukocytes pass into the lungs. A part leaves the veins and disintegrates in the intraalveolar space. Another part reaches the liver after leaving the lungs. Their disintegration is complete after 24 hours. During the leukocytosis phase the bone marrow produces large quantities of new granulocytes. The granulocytes migrate to the lungs, and their history will be the same as that of the leukocytes accumulated during the leukopenia phase. (J.S.R.)

6254 A/CONF.15/P/1729
RADIOISOTOPES AND HEART-ACTIVITY. E. Ernst, J. Tigyi, and A. Niedetzky (Univ. of Pécs, Hungary). 2p.

The effect of beta activity on contractions of isolated frog hearts in Ringer solution was investigated. Contractions of isolated hearts were arrested by changing from Ringer to a potassium-rich solution. When this potassium-rich solution was replaced by another of the same composition but containing potassium-42, the arrested heart started beating. The same reaction was observed when the potassium-42 was replaced by sodium-24 or phosphorus-32. (C.H.)

6255 A/CONF.15/P/1816
IMPORTANCE OF THE DETERMINATION OF THE WEIGHT OF THE THYROID GLAND AND THE CLINICAL BIOLOGICAL FACTORS IN THE TREATMENT OF HYPERTHYROIDISM WITH ^{131}I. W. Clode, V. Sobral, A. M. Baptista, M. A. Perez Fernandez, M. Lusa Martins, L. Botelbo, M. Freire Da Cruz, and F. Magalhães Colaço (Instituto Portugues de Oncologia, Lisbon). 19p.

Clinical results are reviewed for a group of 117 patients treated for hyperthyroidism with iodine-131. The importance of clinical, biological, and physical factors on results is stressed. Various methods for determining thyroid mass are discussed. A visualization technique, called pneumothyroid, is described in which the thyroid volume is determined from a series of x rays and tomographs following the injection of air into the tissue surrounding the thyroid capsule. The apparatus used resembles that used in pneumothorax. This method was found superior to palpation for estimations of thyroid weight prior to calculation of iodine-131 dose. (C.H.)

6256 A/CONF.15/P/1823
EXPERIMENTAL REMARKS ON THE APPLICATION OF ^{51}Cr TO THE STUDY OF HUMAN ERYTHROCYTE. F. M. Bragança Gil and F. A. Carvão Gomes (Instituto de Medicina Tropical, Lisbon). 11p.

Applications of chromium-51 in tracer studies on the life of human erythrocytes are discussed. (C.H.)

6257 A/CONF.15/P/1938
VITAMIN B_{12} IN THE AUTOTROPHIC SULPHUR BACTERIA THIOBACILLUS THIOPARUS. THE BIOSYNTHESIS OF VITAMIN B_{12} UNIFORMLY LABELLED WITH C^{14}. W. Ostrowski (Academy of Medicine, Krakow). 7p.

The autotrophic sulfur bacteria Thiobacillus thioparus was found to synthesize vitamin B_{12} from inorganic salts in the presence of thiosulfate as a source of energy. Vitamin B_{12} was synthesized labeled with carbon-14 in every position, labeled with cobalt-60, and labeled simultaneously with carbon-14, cobalt-60, and phosphorus-32. Quantitative estimation of vitamin B_{12} activity was made by microbiological tests with Euglena gracilis and Ochromonas malhamensis. All the preparations of labeled vitamin B_{12} were used for investigations on the metabolism of cyanocobalamine in animals. (C.H.)

6258 A/CONF.15/P/1939
IDENTIFICATION OF ORGANIC SULPHUR COMPOUNDS FORMED DURING THIOSULPHATE OXIDATION BY THIOBACILLUS THIOPARUS. W. Ostrowski, B. Skarżyński, and T. W. Szczepkowski (Academy of Medicine, Krakow). 10p.

In previous investigations it was demonstrated that the autotrophic sulfur bacteria Th. thioparus utilize only the sulfhydryl group of the thiosulfate molecule. When the –SH group of thiosulfate was labelled with S^{35}, the elementary sulfur and sulfate were radioactive. When the central sulfur atom of thiosulfate was labelled, no radioactivity was detectable in the free sulfur. In the present investigation it was found that hydrogen sulfide is oxidized to free sulfur and sulfate ion. The labelled cysteine and alanylthiosulfate also undergo oxidation; the cysteine is metabolized only in the presence of thiosulfate in the medium. Further studies were undertaken on the primary organic intermediate products containing radioactive sulfur from thiosulfate labelled in both positions. By means of various methods, especially paper chromatography,

paper electrophoresis, and autoradiography it was possible to identify several organic sulfur-containing substances. From the appearance of these labelled intermediates the possible pathway of thiosulfate oxidation was inferred. The mode of utilization of energy from inorganic substances and its transformation for the processes of life are suggested. The free amino-acid pool and the sequence of its synthesis with C^{14} were estimated, and further parts of the metabolic scheme for Th. thioparus are proposed. (auth)

6259 A/CONF.15/P/1946

EFFICIENCIES OF PHOSPHATIC FERTILIZERS FOR RICE ON DIFFERENT SOILS. N. P. Datta and K. B. Mistry (Indian Agricultural Research Inst., New Delhi). 10p.

Data are reported on the utilization of various phosphatic fertilizers under flooded rice growing conditions usually normal in the country. P^{32} labelled superphosphate, ammoniated superphosphate, dicalcium phosphate, calcium metaphosphate, mono and diammonium phosphates, and monocalcium phosphate were applied at 0 and 80 lb P_2O_5/acre to rice grown in greenhouse on a laterite, a black cotton soil, a calcareous alluvium containing about 30 percent calcium carbonate, and an alluvial soil. (auth)

6260 A/CONF.15/P/1947

UTILIZATION OF FERTILIZER PHOSPHORUS BY WHEAT AND RICE FROM DIFFERENT SOILS. N. P. Datta, N. R. Datta, and S. C. Srivastava (Indian Agricultural Research Inst., New Delhi). 9p.

Wheat and rice were grown in a greenhouse on different soils collected from all over the country. Tagged superphosphate was applied at different doses. About fifty percent of these soils responded to phosphorus fertilization. Percent utilization of fertilizer phosphorus applied to these soils varied from 8 to 16, 2 to 9, and 2 to 20 in case of wheat, early paddy and late paddy, respectively. Degrees of phosphorus unsaturation in these soils were determined by Piper's method. The extent of unsaturation was calculated. The unsaturation percentages were found to correlate significantly at 1% level with percentage utilization of labelled superphosphate. It appears that the amount of phosphate the plant can take is limited by the degree of saturation of the exchange complex and that the complex serves as a competing system for available phosphorus and plays an important role in the phenomenon of contact exchange in phosphate nutrition. (C.H.)

6261 A/CONF.15/P/1948

A METHOD FOR RADIOAUTOGRAPHIC STUDY OF MOVEMENT OF PHOSPHORUS IN SOIL COLUMNS. N. P. Datta and S. C. Srivastava (Indian Agricultural Research Inst., New Delhi). 4p.

The method developed uses split plastic tubes with sutures sealed with cellotape. These were found to be better leaching columns for subsequent sectioning for radioautographic study. After the experiment the cellotape was cut along the seams by a sharp edged blade. A stretched steel pianoforte wire passed through the soil column then gives smooth uncontaminated soil sections. This eliminates the necessity of sliding soil columns out of leaching tubes or freezing for subsequent sectioning by band saw. The method along with accessory leaching apparatus and camera described here is adaptable for use on six or more soils in one run. A molded aluminum sheet sliding along the collar of the sectioned half in the camera was used to cut off beta radiation coming from the contaminated upper part of the lucite column. Movement of tagged fertilizer phosphorus in a number of different soils has been studied under the following treatments: superphosphate applied at 40 lb P_2O_5/acre along with other nutrients and leached with water equivalent to a single irrigation dose to wet up to 6 inches, soil composted with 20 tons F.Y.M./acre and then superphosphate applied and leached with water as above, and soil column kept flooded for two weeks under a constant head of 2 inches water, drained, superphosphate applied and leached with half the quantity of water equivalent to one irrigation dose. The depth of movement under treatment was found to be minimum for heavy soils having high free iron oxide content and maximum for light soils of low content of free iron oxide. The effect of composting was to significantly increase the movement in all the soils. In the case of laterite, flooding treatment, which created reducing conditions, was as effective as organic matter in increasing phosphate movement. (auth)

6262 A/CONF.15/P/1955

THE UP-TAKE OF RADIOACTIVE SUBSTANCES THROUGH LEAVES AND GRASS DIRECTLY FROM THE ATMOSPHERE AND THEIR INDIRECT UP-TAKE INTO VEGETABLE FOOD VIA THE SOIL AND THE ROOTS OF THE PLANTS. K. Sommermeyer and K. J. Godt (Univ. of Freiburg i. B.). 7p.

Generally, fall-out radioactive substances can be absorbed in vegetation either via the roots into the metabolism of the plants or by being deposited from the atmosphere directly on the surface of the plants. According to published data only Sr^{90} and Cs^{135} are found in vegetable food and one has to assume that these substances are mostly absorbed by the soil and then transmitted via the metabolism into the food; the same assumption is often made for Sr^{90} up-take through grass. The whole radioactivity of leaves and especially of grass was analyzed, and the following results were found. Radioactive substances are directly deposited from the atmosphere on the surface of the plants and grass and for the most part it is this area on which they are absorbed. This conclusion was reached by comparing the activity on gummed papers which were kept in the open air for a week with the activity of the ash of leaves and grass. The activity on gummed papers as well as of the leaves and grass ash was so high that it was possible to have an analysis of the composition of the γ spectra, using a scintillation spectrometer. The spectra of the activity on gummed papers showed a strong similarity with those of leaves and grass. γ peaks for $Ba^{140} + La^{140}$, $Zr^{95} + Nb^{95}$, Ru^{103}, Ce^{141}, and Ce^{144} were found. The quantitative analysis of the spectra showed conformity for the distribution of the isotope with the distribution of the same isotope, found in nuclear explosion products, assuming the age of activity between 30 and 300 days from the time of explosion. (auth)

6263 A/CONF.15/P/1977

ON THE NECESSITY OF INTRODUCING A NEW RADIOBIOLOGICAL QUANTITY. Radu Grigorovici (C. I. Parhon Univ., Bucharest) and Mircea Oncescu (Inst. de Physique Atomique, Bucharest). 7p.

The introduction of a biophysical quantity, the biological dose, is proposed, which is defined in terms of the absorbed dose and the relative biological effective-

ness. The unit of the biological dose is the rem, while the unit of the absorbed dose is the rad. The rem is the biological dose received by a tissue irradiated by a dose absorbed of 1 rad, with an incident radiation of unit biological effectiveness. (W.D.M.)

6264 A/CONF.15/P/2017
EFFECT OF IONISING RADIATION ON V.L. 13 WHEAT. Boshi Sen, S. N. Srivastava, and M. C. Joshi (Vivekananda Lab., Almora, India). 4p.

A small sample of seeds of V.L. 13 wheat were exposed in the Oak Ridge Reactor tunnel to thermal neutrons at a flux of 1.3×10^9 n/cm^2/sec for 2.8 hours. Both normal and irradiated seeds were germinated in petri dishes to study and observe the coleoptile and root lengths and their survival. The seedlings which survived were then planted in pots and field plots and their vegetative phase carefully recorded. Second generation seeds are being screened for desirable mutants. Preliminary conclusions are presented. (W.D.M.)

6265 A/CONF.15/P/2056
APPLICATION OF RADIOISOTOPES IN CLINICS FOR DIAGNOSIS AND TREATMENT. A. V. Kozlova (U.S.S.R.). 32p.

Applications of radioisotopes for the diagnosis and treatment of diseases are reviewed. Data are tabulated on the clinical condition of a number of patients treated for malignant tumors with radioisotopes. (C.H.)

6266 A/CONF.15/P/2068
ON THE BIOLOGICAL EFFECT OF SMALL DOSES OF IONIZING RADIATION. A. V. Lebedinskii (Lebedinsky), U. G. Grigoryev, and G. G. Demirchoglyan (U.S.S.R.). 36p.

The data on the biological effectiveness of radiation in small doses are of major importance in substantiating the maximum permissible doses. It is generally believed that the mechanism of transmission of hereditary traits is most sensitive to ionizing radiation. Any other biological system in which the restoration processes are insufficiently pronounced may, however, be sensitive to the same extent. Developing organs and systems are especially sensitive. The intermediate action of radiation on the organism through the central nervous system may be considered as an important physiological factor which accounts for the high sensitivity of animals to irradiation. Special methods were employed to demonstrate the high sensitivity of the nervous system to the action of ionizing radiation. Considerations are advanced suggesting absence or limited range of adaptation mechanisms in relation to ionizing radiation. Data are presented on the summation phenomena revealed in the process of malignant neoplasms induced by prolonged exposure to incorporated long-lived fission products in small doses. The material presented calls for a revision of the views held on the biological effectiveness of ionizing radiation in small doses. (auth)

6267 A/CONF.15/P/2069
APPLICATION OF ISOTOPE ENCEPHALOGRAPHY AND ELECTROENCEPHALOSCOPY FOR LOCALIZATION OF BRAIN TUMOURS. V. N. Shamov, C. N. Badmayev, and N. P. Bekhtereva (U.S.S.R.). 15p.

The problems of diagnosis and localization of brain tumors in some cases present many difficulties and make the neurosurgeon seek for additional methods of investigation. In such circumstances usage of the tracer technique in diagnostics is of considerable help, as it has obvious advantages compared with other methods of investigation, such as safety, painlessness, non-traumatism, absence of undesirable after effects, accuracy, and relative simplicity. The present communication is based on the results of clinical observations on 150 patients with verified brain tumors. Analyses of the data show that the accuracy of the brain tumor localizations vary, depending upon the depth of the tumor site and concentration of labelled material in the area of tumor growth. The diagnostic value of the method is doubtful in cases of tumors of posterior fossa, base of the brain, or the lesions of median line. The application of isotope encephalography is successfully supplemented by the new method of investigations, i.e., electroencephaloscopy, which allows the localization of deeply set tumors. Possibilities and limitations of the method are discussed. It is concluded that the isotope encephalography and electroencephaloscopy represent very valuable diagnostic methods which alongside with other auxiliary methods are widely used in diagnosis of brain tumors. (C.H.)

6268 A/CONF.15/P/2070
SOME RESULTS OF THE USE OF TRITIUM TRACER IN BIOLOGICAL RESEARCH. K. M. Bogdanov, M. I. Shalnov, and J. M. Stuckenberg (U.S.S.R.). 27p.

Water metabolism was studied in experiments on mice, rats, and rabbits by means of water tagged with tritium oxide (HTO). Dependence was established of the level of water metabolism on the age of the animals, the dose of the external x and γ irradiation received, and the amount of injected HTO. Curves of elimination of HTO from the organism were obtained, and half-life periods, regularly changing with the dose rate, were calculated. The absorption rate of the tritium-tagged water from the gastrointestinal tract into the blood, as well as the variations after irradiation, was followed. A study was made of the time dependence of the distribution of tritium in the tissues and the organs. Periodicity was revealed in the intake of tritium into the tissue structures and its release back into the water phase. The regularities of metabolism established permit assessment of the extent of radiation damage with change in the half-life period of tritium oxide elimination from the organism, or with the change in the rate of passing through the gastrointestinal tract. The results of the measurements were subjected to mathematical analysis. (auth)

6269 A/CONF.15/P/2071
PUTI ISPOL'ZOVANIYA IONIZIRUYUSHCHEI RADIATSII V PROIZVODSTVE BAKTERIINYKH PREPARATOV. (Ways of Use of Ionizing Radiation in the Manufacture of Bacterial Preparations.) V. L. Troitskii, M. A. Tumanyan, et al. (U.S.S.R.). 27p.

Experiments are reported which give encouraging results for applications of ionizing radiations in the sterilization of vaccines, antitoxins, and serums for use in medical prophylaxis and treatment. A cobalt-60 gamma source was used. A dose of 1.5 Mr had a sterilizing effect, killing not only vegetative bacteria but spore-formers as well. Irradiation with sterilizing doses did not reduce the nutrient properties of meat media used for growth of bacteria of the intestinal group. The formation of diphtheria toxin proceeded on irradiated media the same as on nonirradiated. Irradiation did not reduce the antigenic or immunological properties of typhoid vaccines or diphtheria and tetanus antitoxins. Serum products deteriorated after exposure to sterilizing doses but showed good tolerances to doses which

killed vegetative forms of bacteria. It was concluded that ionizing radiation will prove practical for the preparation of many pharmaceutical products, the cold sterilization of nutrient broth, and the cold sterilization of the wastes from the manufacture of bacterial preparations. (C.H.)

6270 A/CONF.15/P/2072
THE USE OF THE TRACER TECHNIQUE IN THE INVESTIGATIONS OF THE HORMONAL EFFECT ON BONE TISSUE METABOLISM. D. E. Grodzenskii (Grodzensky) and T. I. Ivanenko (U.S.S.R.). 11p.

The effect of stimulating growth hormone, hypophysectomy, and cortisone on metabolism in bone was investigated using radioisotope techniques. The experiments were carried out on intact and hypophysectomized male rats. The animals were killed at various times following the administration of phosphorus-32, calcium-45, and sulfur-35. The incorporation of the isotopes into whole bone and proximal epiphysis of tibia was determined by radiometry and radioautography following hypophysectomy and the injection of stimulating growth hormone and cortisone. Data are tabulated. Application of the data in the standardization of doses of stimulating growth hormone are discussed. (C.H.)

6271 A/CONF.15/P/2073
INVESTIGATION OF THE SIGNIFICANCE OF AUTO-ALLERGY IN THE ORIGIN OF HAEMORRHAGE OCCURRING IN RADIATION SICKNESS. N. N. Klemparskaya and V. V. Shikhodyrov (U.S.S.R.). 14p.

Radiation sickness is characterized by a number of symptoms typical of many allergic diseases, such as variations of body temperature, leukopenia, gastrointestinal disturbances, decrease of blood complement titer, and hemorrhages. These symptoms may result from the sensitization of the organism induced by some unknown allergens, bacteria, food proteins absorbed from the intestinal tract, and disintegration products of the irradiated tissues. The role of these allergens in the sensitization of the organism suffering from radiation sickness was investigated. Subcutaneous injections of the allergens were made into the upper lip of mice and the response followed in irradiated and non-irradiated subjects. Results indicate that the development of hemorrhage accompanying radiation sickness may be due to local allergic reactions caused by the release of the tissue disintegration products in the sensitized organism. (C.H.)

6272 A/CONF.15/P/2074
MECHANISM OF RADIATION EFFECT ON HEREDITY AND PROBLEM OF RADIOSENSITIVITY. N. P. Dubinin (U.S.S.R.). 32p.

Data are compiled from a series of studies on the genetic effects of radiation and factors affecting the radiosensitivity of plants and animals. Data are included from studies on radioinduced aberrations in chromosomes, the genetic effects of radiation on the spermatogonia in monkeys, the genetic effects of radiation on fish embryos exposed during early developmental stages, the radiosensitivity of spermatogenesis in Drosophila exposed at various developmental stages, factors affecting the radiosensitivity of plants, and the effects of radiation on the synthesis of ribonucleic acid. (C.H.)

6273 A/CONF.15/P/2075
EFFECT OF VARIOUS FACTORS ON PROCESSES OF BIOLOGICAL SYNTHESIS OF THYROXINE IN THYROID. E. A. Colley (U.S.S.R.). 25p.

A comparative study was made of various factors which are known to change the functional activity of the thyroid gland and to affect the mechanism of thyroxine formation. Factors investigated include iodides, methyl-thiouracil, thyroxine, thyrotropic hormone, and hypophysectomy, as well as drugs which intensify the processes of excitation or enhance inhibitory processes in the central nervous system which affect the biosynthesis of thyroxine. An effort was made to find the mechanism controlling hormone formation. Test procedures included determinations of the uptake of radioactive iodine, the speed of thyroxine formation, and the activity of proteolytic enzymes of the thyroid gland. Data are tabulated, and conclusions are discussed. (C.H.)

6274 A/CONF.15/P/2076
SRAVNITEL'NAYA KHARAKTERISTIKA SUD'BY V ORGANIZME TREKH FENOTIAZINOVYKH SOEDINENII: S^{35}-AMINAZINA (KHLORPROMAZINA), S^{35}-PROMAZINA I S^{35}-KHLORMEPAZINA (KHLORPAKATALA). (Comparative Characteristics of the Fate of Three Phenothiazine Compounds (S^{35} Aminazine, S^{35} Promazine and S^{35} Chlormepazine) in the Organism.) N. A. Fedorov (Fyodorov) (U.S.S.R.). 27p.

The fate of aminazine, promazine, and chlormepazine in the body was studied, employing a tracer method. The results of studying the dynamics of distribution of the preparations in the organisms of various species of animals with different methods of administration, the findings of the historadioautographic study of the S^{35} aminazine distribution, the results of the experiments on the dynamics of excreting the three preparations from the bodies of rats, dogs, and man, and data on the chromatographic analysis of the excretion products in urine are summarized. (auth)

6275 A/CONF.15/P/2077
OTDALENNYE POSLEDSTVIYA PORAZHENIYA MALYMI DOZAMI RADIOAKTIVNYKH VESHCHESTV V KHRONICHESKOM EKSPERIMENTE. (Long-Term Effects Produced by Small Doses of Radioactive Substances in Chronical Experiment). L. N. Burykina, D. I. Zakutinskii (Zakutinsky), N. A. Kraevskii (Kraievsky), E. B. Kurlyandskaya, N. N. Litvinov, Yu. (Y.) I. Moskalev, A. P. Novikova, Yu. (Y.) N. Solov'ev (Soloviov), and V. N. Strel'tsova (U.S.S.R.) 44p.

Data on the long-term effects produced by radioactive substances administered to dogs, rabbits, and rats in various ways, both in single and repeated doses, are reported. The animals were studied for three years or longer. Three successive phases were found in the chronic irradiation disease caused by the introduction of radioactive substances: the stimulation phase characterized by an instability and variability of clinical symptoms (blood picture, cardio-vascular system, and the physiological system); the phase of apparent compensation when all the symptoms are restored to normal, although changes are recorded in the reactivity of various systems of the organism when functional loads are applied; and the phase when symptoms, typical of the chronic stage of radiation disease, develop. The blastomogenous effects of radioactive substances was given special attention. Pre-tumor changes in the bone was also studied. (J.S.R.)

6276 A/CONF.15/P/2078
OPYTY K OBOSNOVANIYU PREDEL'NO-DOPUSTIMYKH POTOKOV TEPLOVYKH NEITRONOV. (Experiments Designed to Substantiate the Maximum

Permissible Doses of Thermal Neutrons). A. G. Istomina and I. B. Keirim-Markus (U.S.S.R.) 16p.

Experiments were made to determine the maximum permissible doses of thermal neutrons and protons using a paraffin phantom of the human body in which Na_2CO_3 was mixed with the paraffin. It was established that in an isotropic flux of thermal neutrons the gamma dose is constant inside the body, increases when approaching the surface, and decreases on the surface. The dose of protons monotonically decreases toward the center of the body. The maximum permissible fluxes of thermal neutrons on the surface of the body were calculated using several assumptions concerning the relative biological effectiveness (RBE) of protons. It was established that if the RBE of protons is taken as 10, the RBE of thermal neutrons in the parts where a maximum dose is created is equal to 2 to 3. Toward the center of the body the RBE of thermal neutrons decreases and approaches unity. (J.S.R.)

6277 A/CONF.15/P/2079
SPEKTRY ELEKTRONNOGO PARAMAGNITNOGO REZONANSA OBLUCHENNYKH AMINOKISLOT, PEPTIDOV, BELKOV, I LIOFILIZOVANNYKH TKANEI. (Spectra of Electronic Paramagnetic Resonance of Irradiated Amino Acids, Peptides, Proteins and Lyophililized Tissues, and the Mechanism of Primary Action of Ionizing Radiation on Biological Objects). L. A. Blyumenfel'd and A. E. Kalmanson (U.S.S.R.) 15p.

Analysis was made of the spectra of the electronic paramagnetic resonance (EPR) of free radicals appearing as a result of direct action of gamma radiation on biological objects. When amino acids and peptides are irradiated, the free radicals formed produce wide lines of electronic paramagnetic resonance with a superfine structure. Structural interpretation of the electronic paramagnetic resonance spectra observed is possible in a number of cases. The amount of free radicals formed from amino acids and peptides in ionization (i.e., the radical yield of reaction) attains great values. In the majority of native protein preparations (as distinct from amino acids and peptides), the yield of unpaired electrons is very small, being approximately 1000 times less, while electronic paramagnetic resonance spectra are characterized by very narrow single lines without any superfine structure. This testifies to the fact that in the case of proteins most electrons, knocked out by radiation, re-combine with the holes, while the remaining unpaired electrons are delocalized along the protein molecule. When protein preparations are subjected to preliminary denaturation there appear, after irradiation, doublet signals of electronic paramagnetic resonance with a large yield, typical of isolated hydrogen bonds. The data so obtained are helpful in clarifying the mechanism of primary action of ionizing radiation on protein systems and in disclosing the causes of higher radio resistance of proteins. The results are in agreement with the prevailing conceptions regarding the electronic mechanism of migration of energy in protein systems, which are considered to be admixture semiconductors. (auth)

6278 A/CONF.15/P/2080
O NEKOTORYKH TKANEVYKH I KLETOCHNYKH REAKTSIYAKH NA DEISTVIE IONIZIRUYUSHCHEI RADIATSII. (Investigation of Local and Delayed Effects of Ionizing Radiation). E. Ya. Graevskii (E. Y. Graevsky) (U.S.S.R.) 22p.

By the use of morphological and biochemical criteria (in experiments on albino mice subjected to general and local irradiation and on parabiotic animals), alteration in the erythropoietic system, the epithelium of cornea, and intrauterine development were quantitatively investigated. Destructive changes in erythropoietic organs result from local effects of radiation. A decrease of the nucleotide content in bone marrow after irradiation is a delayed reaction. Radiation effects on the cellular division in epithelium of cornea are both local and delayed. The embryo lesion is caused by local radiation effect. Radiation of the mother's organism produces no marked effect on the non-irradiated embryo. The experiments made on infusoria do not corroborate the stimulating effect of small doses of radiation. The experiments revealed no adaptation of cells to the radiation effects. (J.S.R.)

6279 A/CONF.15/P/2081
TECHNIQUES FOR GAMMA ISOTOPE-TRACER STUDIES OF RAPID SUBSTANCE MOVEMENT IN THE LIVING ORGANISM. N. A. Gabelova and G. M. Frank (U.S.S.R.). 28p.

The design is described of a multi-channel counting apparatus which employs a number of scintillation detectors mounted on the ends of flexible pipes and a recording system which provides for time marks. The apparatus was developed for use in tracer studies employing gamma-emitting radioisotopes. The instrument provides a method of nonlinear gamma radiation measurements and provides for the sharp, distinct detection of small changes in gamma intensity. Applications are summarized for a variety of in vivo studies employing sodium-24 and iodine-131 as tracers. These include studies of blood circulation in the heart and spinal cord tumor localization. (C.H.)

6280 A/CONF.15/P/2115
ISPOL'ZOVANIE MECHENYKH SUBSTRATOV DLYA IZUCHENIYA VNUTRIKLETOCHNYKH PROTEAZ. (The Use of Labeled Substrates for the Study of Intracellular Proteases). J. Chaloupka, J. Liebster, and J. Janeček (Czechoslovakia). 10p.

For the study of the intracellular proteolytic system of the microorganism Escherichia coli, casein labeled with I^{131} and bacterial proteins from E. coli biosynthetically labeled with S^{35} were used. Casein-I^{131} proved to be most satisfactory especially because of the simplicity of the radioactivity measurements. The sensitivity and exactness of the determination of the proteolytic activity by means of labeled substrates proved superior to the usual methods. The enzymatic activity in the extracts from bacterial homogenates was investigated. The hydrolysate of casein-I^{131} was chromatographed. An undetermined spot not corresponding to either iodide, diiodo-, or monoiodotyrosine was observed. This spot probably belongs to I^{131}-peptides. The proteolytic system splits casein as well as the bacterial proteins, the optimum pH being between 7.0 and 8.5. The activity of the proteolytic system is considerably decreased by p-chloromercuribenzoic acid, compounds forming metal complexes being ineffective. Hydrolysis of I^{131}-casein by freshly prepared extracts proceeds approximately linearly during the first two hours. The activity of extracts preincubated without substrate at +5°C or +25°C did not increase. This proves the absence of the zymogenic form of the corresponding enzyme in the cell. The presence of bacterial proteins in the extracts does not interfere with the determination of the

proteolytic activity by means of labeled substrates. (auth)

6281 A/CONF.15/P/2116
STUDIES ON THE BIOSYNTHESIS OF ERYTHROMYCIN WITH THE AID OF SUBSTRATES LABELED WITH C^{14}.
Z. Vaněk, J. Majer, A. Babický, J. Liebster, and K. Vereš (Czechoslovakia). 10p.

Results are reported from an investigation of the biosynthesis of the antibiotic substance, erythromycin, by Streptomyces erythreus grown on synthetic culture media containing substrates labeled with carbon-14. (C.H.)

6282 A/CONF.15/P/2118
VLIYANIE PREINKUBATSII NA VKLYUCHENIE METIONINA S^{35} V IZOLIROVANNUYU DIAFRAGMU KRYSY. (The Influence of Preincubation on the Incorporation of Methionine $-S^{35}$ Into the Isolated Rat Diaphragm). R. Žak and A. Babický (Czechoslovakia). 4p.

The effect of preincubation on the incorporation of methionine-S^{35} into the isolated rat diaphragm was studied. The diaphragm was preincubated in a medium without labeled methionine and then transferred into a fresh medium containing the labeled substance. The specific activity of the tissue, preincubated for 15 min. was 30% lower in the following 150 min incubation period than in the control tissue. The possibility of the linear incorporation phase being shortened by the preincubation period was experimentally excluded. The decrease of methionine incorporation was caused by the washing out of a substance indispensable for the incorporation of amino acids. If the diaphragm is incubated in one medium only where the labeled methionine was added after 15 min, the diaphragm did not show any decrease in incorporation. It was determined that the effect of preincubation is related to the level of amino acids in the tissue. (J.S.R.)

6283 A/CONF.15/P/2119
METABOLISM OF METHIONINE IN THE CENTRAL NERVOUS SYSTEM AND RELATION OF PROTEIN METABOLISM TO THE FUNCTION OF THE CNS.
J. Koloušek, Z. Lodin, and J. Fischer (Czechoslovakia). 23p.

Results are reported from a study of the metabolism of methionine-S^{35} and its derivatives in the nervous system, disturbances of protein metabolism of the central nervous system and their relationship to the functional state of nervous tissue, and the chemistry of protein synthesis in the central nervous system in rats. (C.H.)

6284 A/CONF.15/P/2121
DEISTVIE DEZOKSIRIBONUKLEOTIDOV NA KROVETVORNUYU TKAN OBLUCHENNYKH ZHIVOTNYKH. (The Effect of Desoxyribonucleotides on the Hemopoietic Tissue of Irradiated Mammals).
J. Soška, V. Dŕasĭl, and Z. Karpfel (Czechoslovakia). 7p.

The injection of bone marrow or spleen cells into irradiated animals results in a recovery of hemopoiesis. The presence of desoxyribonucleotides was suggested as possible stimulants in this effect. The material to be tested was added to a suspension of bone marrow from irradiated guinea pigs and its ability to cause a restoration of radiation-inhibited DNA synthesis was followed. A chick embryo extract and its nucleotide-containing fraction had a marked positive effect. The effectiveness of ribonucleotides or of ATP was not significant. At the same time these experiments showed that the irradiated marrow had an increased capacity to dephosphorylate the desoxycytidylic acid to cytosindesoxyriboside. Irradiated mice were treated with desoxyribonucleotides. The survival and the hematologic recovery in the peripheral blood were followed. The effect on survival was dependent on the dose of the nucleotide and on the interval between irradiation and injection. The fall of the red cell count was lowered and its recovery was moderately hastened. (J.S.R.)

6285 A/CONF.15/P/2123
IZUCHENIE MEKHANIZMA VYDELENIYA AMINOKISLOT V PITATEL'NUYU SREDU BAKTERIYAMI ESCHERICHIA COLI V PRISUTSTVII KHLORAMFENIKOLA S PRIMENENIEM C^{14}. (Study of the Mechanism of Amino-Acid Liberation by Escherichia Coli in the Presence of Chloramphenicol).
D. Grünberger and F. Šorm (Czechoslovakia). 9p.

Some amino acids are liberated when cultures of E. coli are grown in synthetic inorganic media containing glucose and low concentrations of chloramphenicol. In order to clarify the mechanism of the formation of these amino acids, bacterial cultures were grown in media containing glucose-C^{14} or alanine-C^{14}. The amino acids in the proteins of the bacteria grown in this way were labelled with radioactive carbon. The proteins were isolated from one part of the labelled bacteria. After total hydrolysis and chromatographic separation the specific activity of alanine and glutamic acid were determined. The second part of the labelled bacteria were incubated in a medium which did not contain radioactive substances. The amino-acids were isolated from the medium after different intervals by chromatography and their specific activities were determined. From the high specific activities of the amino acids from the proteins of the bacteria and the lower values of the amino acids liberated in the media it appears that the greater part of the amino acids in the medium is not derived from the proteins of the bacteria present before incubation, but that they are newly synthesized by the bacteria and not further utilized by them. (auth)

6286 A/CONF.15/P/2124
MEKHANIZM ANTIBAKTERIAL'NOGO DEISTVIYA 6-AZAURATSILA-4,5-C^{14}. (Mechanism of the Antibacterial Action of 6-Azauracil-4,5-^{14}C.) J. Škoda and F. Šorm (Czechoslovakia). 6p.

6-Azauracil-C^{14} is converted into 6-azauracil riboside-C^{14} by growing cultures of E. coli; this microbiological reaction was used to prepare relatively large amounts of the carcinostatic 6-azauracil riboside. The formation of 6-azauracil riboside is accompanied by an accumulation in the medium of orotic acid, free uracil, and hypoxanthine. 6-Azauracil is not metabolized in a cell-free extract of E. coli even in the presence of adenosine triphosphate and ribose-5-phosphate. However, the same cell-free extract gives rise to considerable amounts of radioactive nucleotide from 6-azauracil riboside-C^{14} and adenosine triphosphate. The presence of uracil riboside inhibits the formation of 6-azauracil riboside-5'-phosphate. In the absence of adenosine triphosphate not even trace amounts of 6-azauracil riboside-5'-phosphate are formed. (auth)

6287 A/CONF.15/P/2126
DISTRIBUTION OF 6-AZAURACIL-4,5-^{14}C AND ITS RIBOSIDE IN NORMAL AND TUMOROUS ANIMAL

TISSUES. V. Habermann and F. Šorm (Czechoslovakia). 6p.

The distribution of azauracil and its riboside in normal and tumor tissues and of the metabolic derivatives of azauracil in tumor cells was followed after injection of both preparations to mice with Ehrlich ascites tumor. Two hours after the interperitoneal injection of azauracil the relative activity of the tumor cells calculated per mg of dry substance was lower than the activity of the other tissues which had been investigated, in spite of the high concentration of azauracil in the surrounding ascitic exudate. The relative activity was 10 to 50 times higher than that of other tissues after the application of azauracil riboside. It is interesting to note that, unlike azauracil, the riboside barely penetrates into the central nervous system. When the metabolic changes resulting from the application of azauracil were investigated, the activity in the tumor cells was found in the free azauracil and about 30% in azauracil riboside-5'-phosphate. When azauracil riboside was applied, almost all the activity in the tumor cells was present in azauracil monophosphate. None of the above preparations had been incorporated into the nucleic acids of the tumor cells. These results show that azauracil and its riboside interfere with the nucleic acid metabolism at the pyrimidine nucleotide stage. (auth)

6288 A/CONF.15/P/2131
IZUCHENIE DEISTVIYA IONIZIRUYUSHCHIKH IZLUCHENII NA OBMEN VESHCHESTV KLUBNEI KARTOFELYA V SVYAZI S PROBLEMOI EGO KRUGLOGODOVOGO KHRANENIYA. (Application of Ionizing Radiations to Regulating Potato and Vegetables Rest and All-Year-Round Storage.) B. A. Rubin and L. V. Metlitskii (Metlitsky) (U.S.S.R.). 19p.

Investigations made in recent years show that ionizing radiations can prevent potatoes and other vegetables from sprouting in storage. It was found that the delay in sprouting of tubers irradiated by gamma rays is caused by major changes in metabolism. These involve alkalization of the cell contents, shift of the isoelectric zone of proteins and nucleoproteins to acidity, delayed synthesis of nucleic acids at the points of growth, inhibition of the activity of certain oxidases, and retardation of respiration. The sensitivity of oxidases to radiation depends on their nature and location in the protoplasm. The biological effect of the gamma radiation depends on the physiological state of the irradiated tubers, strength of the radiation, and the method of irradiation. Investigation has shown that irradiation has no negative effect on the potato as food. New methods of irradiation were proposed, in conformity with the requirements of modern production. (J.S.R.)

6289 A/CONF.15/P/2132
K VOPROSU O ROLI NADPOCHECHNIKOV V PATOGENEZE LUCHEVOI BOLEZNI. (On the Role of Adrenal Glands in the Development of Radiation Diseases.) A. V. Tonkikh (Tonkih) (U.S.S.R.). 16p.

One of the after effects of x-ray action on the organism is the change in the activity of the cortex of adrenal glands. This change is expressed in its more intensive activity during the first days after irradiation and in a drastic decrease of this activity during the following days. The activity of the cortex of adrenal glands was measured with due account of the efficiency of skeletal muscles. Special experiments have shown that these changes in the cortex of adrenal glands cannot be entirely referred to as the changes in the content of adreno-corticotropic hormon in the organism, ACTH. A possibility of direct reflex influence on the cortex of adrenal glands is not excluded. Previously it was shown that analogous changes in activity also take place in the cerebral layer of adrenal glands. These changes can be revealed from Tonkih-Ilyina phenomenon, i.e., from the presence of the second durable and delayed wave of blood pressure increase which is due to the secretion, under the influence of adrenaline, of vascular hormone by the posterior lobe of the hypophysis. These changes in the activity of adrenal glands may account for some symptoms of radiation disease, e.g., adynamia and hypotonia, caused by participation of cortical hormone and adrenaline in various metabolic reactions. (auth)

6290 A/CONF.15/P/2133
IZUCHENIE PEREDVIZHENIYA, RASPREDELENIYA I PREVRASHCHENIYA NEKOTORYKH FIZIOLOGICHESKI AKTIVNYKH VESHCHESTV V RASTENII. (A Study of the Translocation and Transformation of some Physiologically Active Substances in the Plant.) Yu. V. Rakitin (Y.V. Rackitin) and A. V. Krylov (Kryhlov) (U.S.S.R.). 17p.

For the investigation of the translocation of substances in plants α-naphthylacetic acid-C^{14} and paraiodinephenoxyl acetic acid-I^{131} were used. Solutions of these compounds were injected though a leaf petiole deprived of blade or through the root system of tomato plants. The distribution of the compounds was measured radiometrically. It was found that the highest radioactivity was located in the growing points, young growing fruits, and terminal leaves. The distribution of these compounds is highly dependent on the intensity of metabolism. To study the transformation of compounds in plants α-naphthylacetic acid was injected in tomato plants, potato tubers were kept in the vapor of the methyl ether of α-naphthylacetic acid, and Japanese persimmon fruits were injected with methyl and ethyl alcohols. It was found that the plants rather intensively expired carbon dioxide containing C^{14}. The experimental results showed that all the preparations are subjected in the tissues to profound biological changes which are accompanied by detoxication and loss of physiological activity of the compounds. (J.S.R.)

6291 A/CONF.15/P/2134
THE USE OF CARBON^{14} AND NITROGEN^{15} IN THE STUDY OF MUSCLE METABOLISM. D. L. Ferdman (U.S.S.R.). 19p.

Results are reported from studies employing carbon-14 and nitrogen-15 in studies on muscle metabolism in rabbits. Data are presented on the metabolism of glycogen, amino acids, and glutamine during various functional states. Reaction pathways in metabolism are discussed. (C.H.)

6292 A/CONF.15/P/2135
ISSLEDOVANIYA FOTOSINTEZA PRI POMOSHCHI KOLICHESTVENNYKH RADIOMETRICHESKIKH METODOV. (Quantitative Methods of Investigation of Photosynthesis with the Aid of Radioactive Carbon). O. V. Zalenskii, V. L. Voznesenskii, and O. A. Semikhatova (U.S.S.R.). 23p.

Examples are presented of the application of quantitative methods using carbon-14 in investigations of reaction mechanisms in photosynthesis, the relationship between photosynthesis and respiration in plants, the

translocation of carbon assimilated by plant leaves, and its distribution throughout the plant. (C.H.)

6293 A/CONF.15/P/2180
RADIOACTIVE IODINE STUDIES IN NORMALS AND IN VARIOUS THYROID DISORDERS AMONG FILIPINOS. Paulo C. Campos, Augusto D. Litonjua, et al. (Univ. of the Philippines and Philippine General Hospital Medical Center, Manilla). 38p.

Results are presented from measurements of the radioactive iodine uptake in 177 subjects. Of this number 60 were normal, 41 presented goiter but were clinically euthyroid, 48 were hyperthyroid, 8 were hypothyroid, and 20 were suffering from other diseases. Measurements of radioiodine uptake were made over the thyroid at the end of the 1st, 2nd, 6th, 24th, and 48th hour. It was concluded that for practical and routine diagnostic tests the 24-hour uptake is sufficiently reliable. Simultaneous measurements were also made of the protein-bound iodine-131 conversion ratio and the total accountable iodide-131. An investigation was also made of the total dietary iodide intake of the subjects over a 24-hour period. (C.H.)

6294 A/CONF.15/P/2200
REABSORBTSIONNYE YAVLENIYA V MOLOCHNOI ZHELEZE. (Reabsorption Phenomena in the Mammary Gland.) G. I. Azimov (U.S.S.R.). 11p.

A tracer study of the physiology of the mammary gland was made. The results showed that milk secretions take place with reabsorption of certain substances from the blood. If labeled P, S, or Ca are administered through a teat of a goat or cow udder, the elements are soon detected in the milk discharged from another teat. Milking or massaging the udder intensifies the absorption process. It is shown that the organic milk components contain no labeled P for some time, but inorganic P appears after a few minutes. Pituitrin, administered to a lactating goat, produces the same effect on reabsorption in the mammary gland as milking or massaging of the udder. (J.S.R.)

6295 A/CONF.15/P/2202
O MEKHANIZME REGULYATSII FUNKTSII SHCHITOVIDNOI ZHELEZY KOROI GOLOVNOGO MOZGA. (Mechanism of Regulating Thyroid Gland Functioning by Brain Cortex.) M. G. Amiragova (U.S.S.R.). 24p.

Results are reported from tracer studies which show that the influence of the brain on activity of the thyroid gland is mediated through hormonal links involving either secretions from the hypophysis of the pituitary or the adrenal glands. (C.H.)

6296 A/CONF.15/P/2233
RHYTHMICITY IN THE ABSORPTION AND ELIMINATION ACTIVITY OF THE ROOTS. I. I. Gunar, E. E. Krastina, and A. E. Petrov-Spiridonov (K. A. Timiriasev Agricultural Academy, Moscow). 41p.

Rhythmical alterations of physiological processes in the root systems of plants were established with the aid of tracer techniques employing phosphorus-32 labeled phosphates, sulfur-35 labeled sulfates, and potassium and calcium determined by polarographic methods. Factors influencing the rhythmic pattern are discussed. (C.H.)

6297 A/CONF.15/P/2237
SOME PROBLEMS OF BIOLOGICAL ANALYSIS OF RADIOBIOLOGICAL EFFECTS. G. M. Frank, N. A. Aladjalova, and A. D. Snezhko (U.S.S.R.). 48p.

Problems are discussed which are encountered in extrapolating results from model studies of radioinduced physico-chemical changes to effects of radiation on complex organisms. It is pointed out that the process of inactivation does not culminate during irradiation but continues to develop for a long time. Reaction mechanisms affecting radiation injury and protection against radiation injuries in protein solutions are discussed in detail. It is pointed out that fundamental differences in radiosensitivity which are determined in vivo can seldom be compared with those determined in vitro. Illustrative data are reviewed from a number of radiobiological studies ranging from simple models of ferment systems, through nucleoprotein solutions, cells, and mammals. (C.H.)

6298 A/CONF.15/P/2238
EXPERIENCE OF TREATMENT AND PROPHYLAXIS OF RADIATION DISEASE WITH LEUCOCYTE AND THROMBOCYTE MASSES. A. A. Bagdasarov, F. K. Vinograd-Finkel, et al. (U.S.S.R.). 21p.

Beneficial effects are reported following the administration of mass transfusions of leukocytes or thrombocytes to dogs following exposure to LD_{95} doses of whole-body x radiation. Transfused thrombocytes labeled with chromium-51 were observed in the blood of recipients 7 days after transfusion. Good results are reported in patients suffering from radiation sickness induced by radiation therapy treated with repeated mass transfusions of leukocytes prepared from non-citrated blood and preserved with the aid of ion-exchange resins. This method of preservation was found to result in a prolonged viability of leukocytes. The mass leukocytes also contained some thrombocytes. One dose of mass leukocytes prepared from 450 ml of blood contains an average of 2 billion leukocytes. From 3 to 8 transfusions were necessary to attain positive results. In cases of significant thrombocyte decrease additional transfusions of mass thrombocytes were given. The administration of mass leukocyte transfusions at the beginning of radiation therapy prevented or reduced the development of leukopenia and other disorders of hematopoiesis. (C.H.)

6299 A/CONF.15/P/2239
ATSETILIRUYUSHCHAYA FUNITSIYA SISTEMY KOENZIMA A PRI LUCHEVOI BOLEZNI. (Acetylating Function of the System of Coenzyme A in Radiation Disease.) I. F. Seits (U.S.S.R.). 11p.

A study was made of the acetylating function of the coenzyme A system and of the changes in the concentration of the coenzyme in the liver of a pigeon in the case of acute radiation disease caused by a single dose of 2,000 to 3,000 r x radiation. The acetylating activity was measured in the intact liver homogenates and in the autolyzed extracts from acetonic powders prepared from the liver tissue. Acetylation in the liver homogenates of irradiated pigeons was strongly suppressed. The characteristics of both fermentative and cofermentative components of the acetylation system were given. It was determined that the amount of coenzyme A in the liver is decreased by radiation and that the activity of the ferments which participate in the transport of the acetylic groups is also decreased. The activity of the acetate thiokynase is the most affected, and the ferment participating in the primary activation of the acetate is least affected. (J.S.R.)

6300 A/CONF.15/P/2244
PECULIARITIES OF PROTEIN SYNTHESIS IN PLANT

AND ANIMAL CELLS. N. M. Sissakian (U.S.S.R.). 19p.

Results are reported from an investigation of peptide bond synthesis in plants and animals. Tracer techniques using carbon-14-labeled glycine were combined with biochemical methods. The synthesis of peptide bonds in plant and animal cells is due not only to direct utilization of free amino acids but to peptides as well. Yet the protein synthesis in insect body fluid is realized chiefly at the expense of peptides. Amino acids stimulate the synthesis of peptide bonds. The qualitative composition of amino acids is an important factor in that synthesis. The energetic conditions for formation of peptide bonds in animal and plant cells are quite different; hence the inhibitory effect upon the peptide bond synthesis varies. An inadequacy between the protein synthesis and the incorporation of labeled amino acids into the protein molecule was observed. The age and physiological state of an organism have a decisive influence upon the peptide bond synthesis and its breakdown in protoplasm structures of both plant and animal cells. (C.H.)

6301 A/CONF.15/P/2248
PRIMARY REACTIONS IN BIOLIPIDS INDUCED BY IONIZING RADIATION. B. N. Tarusov (U.S.S.R.). 10p.

Results obtained in studies of radiochemical reactions arising in biolipids in vivo and in vitro are summarized. The kinetics of reactions in biocolloids as a function of irradiation dose were investigated. Attention was given to the problem of toxic agents which are produced in the process of radio-oxidation of lipids and which affect the links of intermediate metabolism. Experimental data are presented on the mechanisms of inactivation of natural antioxidants which set in when incipient reactions of radiation after-effect are developing. On the basis of the data obtained the author makes some suggestions about the influence these radiochemical reactions exert on the quantitative regularities of the radiation damage. (auth)

6302 A/CONF.15/P/2251
RECHERCHES SUR LES BARBITURIQUES RADIOACTIFS: LA DISTRIBUTION DU LUMINAL DANS L'ORGANISME ANIMAL EN PRESENCE DE CAFEINE. (Antagonism Between Luminal and Caffeine, Studied by the Use of Radioisotopes.) B. Aliprandi and R. Masironi (Centro per la Chimica Nucleare del C.N.R., Rome). 6p.

The normal pattern of distribution of luminal in the animal organism was determined in mice using a tracer technique. The effect of an antagonistic drug, e.g., caffeine, on this normal distribution pattern was studied. The results confirmed the hypothesis of the in vivo breaking of the barbituric ring. (J.S.R.)

6303 A/CONF.15/P/2252
THE FATE OF C^{14} BROMOACETIC ACID IN THE MOUSE. M. Quintiliani and M. Boccacci (Inst. Superiore de Sanitá, Rome). 14p.

The distribution of radioactivity in various organs and tissues of mice was studied by injecting intravenously some sodium bromoacetate-2-C^{14} with a dose corresponding to a LD_{50} (31 mg/kg of body weight). The radioactivity in the blood was then followed as a function of time. Examining with paper chromatography some deproteinized blood samples, taken at different times, it was possible to observe the complete disappearance of bromoacetate from the blood within 20 minutes from the injection. Therefore the measurements concerning the fate of the drug were carried out after 30 minutes from the administration. At this time, the blood radioactivity is found chiefly in the liquid part as non-protein compounds. The part bound to the proteins seems homogeneously distributed among the different fractions; the proteins to which radioactivity is bound showed an electrophoretic mobility remarkably lower than the one showed by the normal fractions. In the extracts of muscular proteins with low ionic strength, radioactivity appears uniformly distributed among the different protein components. A table is included which shows the radioactivity values in the different organs and tissues. (auth)

6304 A/CONF.15/P/2254
METHOD FOR THE STUDY OF THE LIVER BLOOD FLOW USING GAMMA-EMITTING RADIONUCLIDES. A. M. Baptista and J. Silva Carvalho (Inst. Portugues de Oncologia, Lisbon). 18p.

A method is described for the evaluation of liver blood flow values by radioactivity measurements of gamma-emitting radionuclides, in colloid form, using a scintillation detector positioned over the liver region. It is shown that the disappearance rate constant of the nuclide from the blood can be calculated from the curves obtained. Advantages of the method, including the use of small amounts of radioactive materials, are discussed. (auth)

6305 A/CONF.15/P/2258
TRAINING IN NUCLEAR MEDICINE. Tede E. de Eston and Veronica Rapp de Eston (Univ. of São Paulo, Brazil). 12p.

An account is given of how the Isotope Laboratory of the Faculty of Medicine of the University of São Paulo has handled the problem of a rapid and continuously expanding radioisotope program in the past, and present and future possibilities of the program. A separate building is now under construction which will concentrate all radioisotope applications, providing unique facilities for broad developments in nuclear medicine. (auth)

6306 A/CONF.15/P/2266
THE ACTION OF ATROPINE ON PANCREATIC SECRETION. L. C. U. Junqueira, Hanna A. Rothschild, and I. Vugman (Univ. of São Paulo, Brazil). 9p.

The action of atropine, in preventing pancreatic secretion in response to a parasympathomimetic drug, is analyzed. Atropine does not appear to affect the uptake of radioactive glycine by the pancreatic cell, or the incorporation of radioactive amino acids into the total pancreatic tissue proteins, or into the proteins of the zymogen granules. The rate of amylase resynthesis in stimulated glands is not affected by atropine. It is suggested that atropine blocks pancreatic secretion in rats by blocking the extrusion of zymogen granules. (auth)

6307 A/CONF.15/P/2280
METHODS FOR THE DETERMINATION OF THYROID FUNCTION AND DIFFERENTIATION OF DIFFERENT PATHOPHYSIOLOGIC TYPES. Nelson Carvalho, Lieselotte J. Genter, and Eliseario F. Vasconcellos (Univ. of São Paulo, Brazil). 15p.

Results are reported from a series of 1300 tests for the determination of thyroid function by the uptake of iodine-131. The procedures used are outlined. Data are tabulated on radioiodine uptake, other tests, and clinical results. (C.H.)

6308 A/CONF.15/P/2281
A COMPARATIVE ANALYSIS OF THE EFFECTS OF

NATURAL AND OF RADIATION INDUCED LETHALS IN HETEROZYGOUS INDIVIDUALS AND OF THEIR FREQUENCIES IN NATURAL POPULATIONS OF DROSOPHILA WILLISTONI. A. B. da Cunha, J. S. de Toledo, C. Pavan, et al. (Univ. of São Paulo, Brazil). 8p.

Results are presented from a comparative analysis of the effects of natural and of radiation-induced lethals in heterozygous individuals and of their frequencies in natural populations of Drosophila willistoni. (C.H.)

6309 A/CONF.15/P/2309
SOME RESULTS OF THE USE OF TRACER TECHNIQUES IN THE STUDY OF PLANT PROTECTION. S. B. Andrejev, A. V. Vsevodin, C. A. Molchanova, and A. V. Khotjanovitch (U.S.S.R.). 28p.

Techniques employing radioisotopes were developed for the investigation of methods for the control of plant crop pests. Radioactive carbon, phosphorus, sulfur, zinc, and cobalt were used in studies on the uptake and mechanisms of toxic action of various insecticides, herbicides, and zoocides in noxious insects, rodents, weeds, and agricultural plants. Radioisotopes were also employed in studies of the migration and behavior of various pests. (C.H.)

6310 A/CONF.15/P/2311
UPTAKE OF STRONTIUM, CESIUM AND SOME OTHER FISSION PRODUCTS BY PLANTS AND THEIR ACCUMULATION IN CROP YIELD. I. V. Gulyakin and E. V. Yudintseva (U.S.S.R.). 25p.

The results of investigations conducted by the authors on the uptake of strontium-90, cesium-137, cerium-144, zirconium-95, ruthenium-106, and some other fission products by various agricultural plants summarized. Data on the distribution of the elements in plants and their accumulation in different parts of the crop plants as a function of biological characteristics of the plant environmental conditions are given. Possible agrochemical and agrotechnical aspects of the problem of controlling processes responsible for the amount of fission products accumulated and the ratio between strontium and calcium, and cesium and potassium in crop plants are considered. The results of the investigations show that the accumulation of radioactive fission products during the vegetative period increases with the growth of the above-ground mass of the plant. Reproductive organs of plant accumulate radioisotopes of strontium and cesium in greater amount than other fission products. Data are tabulated. (C.H.)

6311 A/CONF.15/P/2312
THE EFFECT OF RHIZOSPHERE MICROORGANISMS UPON THE UPTAKE AND RELEASE OF PHOSPHORUS AND SULPHUR BY THE ROOTS OF ARBOREAL SEEDLINGS. A. I. Akhromeiko and V. A. Shestakova (U.S.S.R.). 20p.

Phosphorus-32 was used in tracer studies of the relationship between rhizosphere microörganisms and higher plants. Vigorous development of microörganisms within the rhizosphere was found to inhibit temporarily phosphorus entry into oak and ash tree seedlings, but an appreciable portion of the phosphorus taken up by the microörganisms became available for the plants after 10 days. Rizosphere microörganisms were found to take up phosphorus compounds secreted by the seedling roots, thereby stimulating secretion of new portions of these compounds into the sand and water medium. A diurnal rhythm was noted both in the rate of root secretion of phosphorus and sulfur and in bacterial growth. Phosphorus containing root secretions also stimulated the growth of Azotobacter cells in the root system. (C.H.)

6312 A/CONF.15/P/2313
THE RELATION BETWEEN THE RADIOACTIVE PHOSPHORUS ABSORPTION IN AGRICULTURAL CROPS AND THEIR FROST-RESISTANCE. V. I. Razumov and N. D. Feofanova (U.S.S.R.). 13p.

An attempt was made to evaluate the frost resistance of winter wheat and several other agricultural crops by measuring the absorption of phosphorus-32 at various temperatures. Data are tabulated. (C.H.)

6313 A/CONF.15/P/2314
SKIN PERMEABILITY TO LABELLED SULPHUR, ITS INCORPORATION INTO WOOL PROTEINS AND EXCRETION FROM THE ANIMAL ORGANISM. I. A. Troitskii (Troitsky) (U.S.S.R.). 16p.

Sulfur-35 was used in a study of the penetration of sulfur compounds through the skin of sheep and rabbits. Data indicate that sulfur metabolism in the skin of wool-bearing animals proceeds at a high rate and that sulfur-containing proteins used for building hair keratin may be synthesized in the skin. Applications of the findings in studies on the skin absorption of drugs used in medical and veterinary dermatology are suggested. Data are included on the metabolism and incorporation in wool proteins of sulfur-35 following ingestion by sheep and rabbits. The radioactivity of cystine isolated from the wool of sheep following the ingestion of sulfur-35 was measured over a 40-day period. (C.H.)

6314 A/CONF.15/P/2315
IZMENENIYA NASTUPAYUSHCHIE V NERVNOI SISTEME POSLE VOZDEISTVIYA IONIZIRUYUSHCHEI RADIATSII. (Central Nervous System Changes Produced by Ionizing Radiation.) M. N. Lifanov and D. A. Birjukov (U.S.S.R.). 36p.

Experimental results showing the functional disturbances in some parts of the central nervous system of rabbits exposed to a single whole-body x radiation are reported. Functional changes of exteroceptive and interoceptive mechanisms and of spinal reflexes, as well as changes in the brain stem and brain cortex activity, were observed. Bioelectrical phenomena in various tissues, spinal and postural reflexes, respiratory functions, and conditioned reflexes were studied. The role played by subcortical centers in the development of the radiation-induced changes in the central nervous system was also considered. It was concluded that, although the brain cortex in higher animals suffers pronounced injury from ionizing radiation, the functional disturbances and disorders occurring in subcortical centers also play an important role in radiation sickness pathogenesis. (J.S.R.)

6315 A/CONF.15/P/2316
PATHOPHYSIOLOGICAL ASPECT OF THE PROBLEM OF PATHOGENESIS OF THE ACUTE RADIATION DISEASE. P. D. Gorizontov (U.S.S.R.). 67p.

A comprehensive review is presented of the clinical picture and various syndromes associated in radiation sickness. It is emphasized that as yet no all embracing theory of the pathogenesis of radiation sickness can be formulated. A review of available data leads to the conclusion that ionizing radiation produces direct changes in the tissues, disorders of neuro-endocrine regulation, and a modification of the reactivity of the organism. The damaging action of ionizing radiation is thus revealed

by a number of pathogenic mechanisms. This is demonstrated by the fact that the causes of death from radiation injuries may vary with the conditions of irradiation, the period of the development of the disease, and the individual reactivity of the organism. 203 references. (C.H.)

6316 A/CONF.15/P/2317
RADIOAKTIVNYE IZOTOPY V RESHENII PROBLEM GIDROBIOLOGII. (Isotopes in Solving Hydrobiology Problems.) V. I. Zhadin, S. I. Kuznetsov, and N. V. Timofeev-Resovskii (Timofeyev-Ressovsky) (U.S.S.R.). 20p.

A survey is presented on the uses of radioisotopes in the field of hydrobiology. The primary problems in hydrobiology are the perfecting of the theory of biological productivity in water bodies (and on this basis the exploration of methods for increasing this productivity) and the study of methods for preventing the contamination of water by industrial sewage, especially radioactive substances. The results of studies in these problems are reported. 27 references. (J.S.R.)

6317 A/CONF.15/P/2318
ISPOL'ZOVANIE FOSFORNYKH EFIROV KHOLINA, ETANOLAMINA I SERINA V SINTEZE FOSFOLIPIDOV V GOLOVNOM MOZGU. (Application of Phosphorous Esters of Choline, Ethanolamine and Serine to Phospholipides Synthesis in Brain.) P. A. Kometiani, L. K. Tkeshelashvili, and T. A. Ovsyanko (U.S.S.R.). 13p.

Phosphorus esters of choline and ethanolamine in the brain constitute 5% of the acid soluble phosphorus fraction. P^{32}-labeled phosphoryl ethanolamine, phosphorylcholine, and phosphorylserine were used to find their role in phospholipid synthesis. Five hours after suboccipital and eighteen hours after subcutaneous administration of the labeled compounds to dogs and rabbits the animal was killed and the following phosphorus fractions in the brain were estimated: inorganic phosphorus, total acid soluble phosphorus, choline and ethanolamine phosphorus esters, and the total lipoid, nucleic, and protein phosphorus. The results showed that phosphorus esters of choline, ethanolamine, and serine in brain hemogenates do not incorporate into the corresponding phospholipids. (J.S.R.)

6318 A/CONF.15/P/2319
ON THE ROLE OF NUCLEOPROTEIN NATIVE STATE CHANGES IN RADIATION DAMAGE. A. M. Kusin and A. I. Shabadash (Schabadasch) (U.S.S.R.) 30p.

Biochemical and histochemical studies were made of radioinduced changes in the nucleoproteins of plant and animal cells. A comparison was made of the radiosensitivity of chromosomes, mitochondria, plant cell chloroplasts, and photosynthetic activity in radiosensitive and radioresistant plants. The influence of desoxy and ribonucleoprotein content on radiosensitivity is discussed. (C.H.)

6319 A/CONF.15/P/2320
ACTION OF IONIZING RADIATIONS AND RADIOMIMETIC SUBSTANCES ON THE MICROBE CELL. M. Meissel, R. Galtsova, G. Medvedeva, N. Pomoshchnikova, L. Seliverstova, and M. Shalnova (U.S.S.R.). 29p.

Results are reported from a study on the structural, functional, and biochemical features of cytoplasm in yeast cells and the changes induced by radiation. Observations were made in yeast cells. Special attention was focused on metabolic processes and the functional characteristics of the mitochondria and microsomes. (C.H.)

6320 A/CONF.15/P/2321
TREATMENT OF SILKWORM COCOONS BY RADIATION. U. A. Ariffov, I. D. Artmeladze, V. A. Barnov, et al. (U.S.S.R.). 23p.

The existing methods of silkworm cocoon treatment, including heat, chemicals, and vacuum, essentially damage the silk thread and considerably decrease the yield of raw silk as compared with untreated cocoons. A possibility of treating the silkworm chrysalis by Co^{60} γ rays was studied in this connection. A comparative study of the properties of the silk thread obtained by this method was made. The nature of radiation effects of γ rays on the substance of the silk thread was investigated. While the cocoons treated in vacuum decompose when stored, the irradiated cocoons are preserved well in storage for many months, additional preservation being unnecessary. Moreover, γ rays have a beneficial effect on the thread properties. The unwinding of the cocoons becomes much easier, and the return and break coefficients become lower. Such properties of the cocoon shell as swelling and water permeability improve as well. The knitting property of the irradiated cocoon thread is better than that of the thread of the heat-treated cocoons or of the raw cocoons. (C.H.)

6321 A/CONF.15/P/2328
INVESTIGATION ON THE PHYSIOPATHOLOGY OF UNCINARIASIS. Marcel Roche (Inst. Venezolano de Investigaciones Cientificas). 19p.

Various factors which might influence the development of anemia in hookworm infection were studied with the help of iron-59 and chromium-51. With Cr^{51}, it was possible to measure the quantity of blood lost into the intestine. Erythrocyte survival after correction for the amount of Cr^{51} lost by way of the feces is normal in the majority of cases. The iron plasma disappearance and the incorporation of iron in hemoglobin were studied with iron-59. Absorption and utilization of iron from black beans, the main source of dietary iron of the population, was studied. With the simultaneous use of Fe^{59} and Cr^{51}, it was possible to show that an appreciable quantity of lost iron, of the order of 40 to 60%, is reabsorbed from the gastrointestinal tract. (auth)

6322 A/CONF.15/P/2330
STUDIES IN ENDEMIC GOITER WITH RADIOACTIVE IODINE. F. De Venanzi, M. Roche, and K. Gaede (Inst. de Investigaciones Médicas Fundación Luís Roche, Caracas). 4p.

Results from studies with radioiodine show that goitrous patients exhibit a decreased urinary excretion of iodine, low salivary radioactivity, increased thyroid clearance with normal urinary clearance, and increased protein-bound I^{131} and conversion ratio. All of these results are analogous to those found in hyperthyroidal states. On the other hand the test of triiodothyronine fixation on erythrocytes was found to be significantly low in endemic goiter, below the normal level found in non-endemic areas, and within myxedematous levels. The changes with tests involving radioactive iodine support the hypothesis of iodine lack as a primary etiological factor in endemic goiter. There was no significant difference between goitrous and non-goitrous groups with respect to I^{131} thyroid uptake. However, in areas where goiter was less prevalent, the uptake in goitrous patients was higher than that of the non-goitrous living in the same area, though such difference

could have been attributable to geometry since a study of the urinary excretion in this area revealed no significant difference between the two groups. This finding might suggest that iodine lack is not the only factor in the production of goiter. In general, however, there was a rough correlation between incidence of goiter in a population and average thyroid uptake. (auth)

6323 A/CONF.15/P/2414
STUDY OF CATHEPSIN C ACTIVITY FROM ISOLATED BEEF SPLEEN IRRADIATED WITH GAMMA RAYS. D. Lebaz, S. Klemenc-Šebek, and L. Strauch (J. Stefan Inst., Ljubljana, Yugoslavia). 5p.

The spleen of adult cattle, removed immediately after slaughtering, was subjected to gamma irradiation and kept at temperatures of 10 to 15°C for some time. Control material was kept at the same temperature for the same length of time. The Cathepsin C was extracted and the activity determined. The results showed that under the same conditions, almost equal amounts of enzyme protein can be extracted from the irradiated and control samples of beef spleen. However, the specific activity of the irradiated spleen is considerably increased. The process of activity increase starts soon after irradiation and continues with time. These results indicate that only the specific activity of Cathepsin C is increased, while the increase of the protein fraction containing the enzyme is negligible. (J.S.R.)

6324 A/CONF.15/P/2445
THE TRIIODOTHYRONINE SUPPRESSION TEST IN THE DIAGNOSIS OF TOXIC AND NON-TOXIC GOITERS. S. Artunkal, T. Kapicioğlu, and V. Seyahi (Istanbul Univ.). 5p.

Applications of iodine-131 uptake studies in the diagnosis of toxic and non-toxic goiters are discussed. (C.H.)

6325 A/CONF.15/P/2468
PALLAS BARLEY, A VARIETY PRODUCED BY IONIZING RADIATION: ITS SIGNIFICANCE FOR PLANT BREEDING AND EVOLUTION. G. Borg, K. Fröier, and Å. Gustafsson (Swedish Seed Assn., Svalöf and Forest Research Inst. of Sweden, Stockholm). 26p.

Results are reported from plant breeding programs in which mutations induced in barley by irradiation resulted in the development of a variety with characteristics superior to the parents. Good results were also reported in the development of superior varieties of oil rape, white mustard, and pea plants. The usefulness of radiation-induced mutations in plant breeding programs is discussed. (C.H.)

6326 A/CONF.15/P/2476
TSITOGENETICHESKII EFFEKT VOZDEISTVIYA IONIZIRUYUSHCHEGO IZLUCHENIYA NA YADRA ZARODYSHEVYKH KLETOK OBYAZ'YAN. (Cytogenetic Effect of Ionizing Irradiation on the Spermatogenesis in Monkeys.) G. G. Tinyakov and M. A. Arsen'eva (U.S.S.R.). 19p.

Exposure to total-body irradiation with 150 to 450 r resulted in considerable nuclear distrubances at various stages of spermatogenesis. Among the observed disturbances were: pycnosis and degeneration of nuclei, adhesion of chromosomes, nuclear decay into karyosomes and lumps, formations of double or quadruple nuclear cells, disturbances in the fusiform apparatus, anaphase bridges, and acentric fragments. A single exposure to 150 to 450 r produced injurious effects on the sexual gland cells which lasted for 2 years and probably will continue during the rest of life. Experimental data on the effects of radiation on the hereditary structures in apes and mice showed a much stronger radiosensitivity in apes. The conception of cell destruction as the result of unbalanced nuclei, following a long period after irradiation, which leads to the exclusion of cytogenic effects of irradiation was proved to be erroneous. (R.V.J.)

6327 A/CONF.15/P/2479
LABELLING OF CALF THYMUS HISTONE WITH RADIOIODINE I-131. S. Hupka, L. Hnilica, and V. Gregušová (Czechoslovakia). 8p.

Three iodination procedures were tested for labeling calf thymus histone with iodine-131 in vitro. Iodination procedures caused structural changes in the form of high molecular aggregates. The H_2O_2 iodination was found most suitable. The stability of the preparations was tested in vivo following administration to rats. (C.H.)

6328 A/CONF.15/P/2480
INDIVIDUAL DIFFERENCES IN THE REACTION OF IRRADIATED EXPERIMENTAL ANIMALS AND THEIR REFLEXION IN THE COURSE OF METABOLIC PROCESSES. L. Novák and M. Pospíšil (Czechoslovakia). 11p.

Individual differences in metabolism during sleep and active periods while adapting to an experimental environment were compared with differences in radiosensitivity following exposure of rabbits to single doses of 700 r x radiation. Animals showing average values of oxygen consumption while making the environmental adaptation survived the irradiation, while animals showing extreme variations in oxygen consumption did not survive for 30 days. A direct relation between the level of blood lipemia and respiratory oxygen consumption after irradiation was also observed. The results are discussed. (C.H.)

6329 A/CONF.15/P/2481
OTNOSHENIE MEZHDU ANEMIEI I KOLICHESTVOM OBSHCHIKH ZHIROV V PECHENOCHNOI TKANI U OBLUCHENNYKH MYSHEI I KRYS. (The Relation between Anemia and the Fat Concentrations in Liver Tissues in Irradiated Mice and Rats.) M. Skalka (Czechoslovakia). 7p.

The relation between anemia and general fat concentrations in liver tissues was determined in mice and rats two weeks following whole-body exposure to 500 to 640 r. An increased amount of liver fats was observed in rats whose erythrocytes count fell below 2 to 2.5 mil/mm^3, and in mice whose erythrocyte count fell below 4 to 5 mil/mm^3. Experiments indicated the great importance of anemia in final stages of radiation sickness. (R.V.J.)

6330 A/CONF.15/P/2496
THE MEDICAL VALUE OF THE LOCALISATION OF RADIOACTIVE ISOTOPES. E. E. Pochin (University College Hospital Medical School, London). 7p.

Many of the most important medical applications of radioactive isotopes depend upon the selective concentration of certain elements in various organs or tissues of the body. Factors affecting such localizations are reviewed. (C.H.)

6331 A/CONF.15/P/2498
THE DETECTION OF DEOXYCYTIDINE IN URINE AS AN INDICATOR OF CHANGES AFTER IRRADIATION.

J. Přŕízek, M. Arient, Z. Dienstbier, and J. Škoda (Czechoslovakia). 6p.

Increased excretion of desoxycytidine was demonstrated in urine from irradiated rats. The analytical method is described, and results are discussed. Corresponding amounts of other pyrimidine components of desoxyribonucleic acid, thymine, or its components were not found in the urine. Preliminary examination of subjects professionally exposed to ionizing radiation, with both external and internal contamination, shows that this could be a sensitive indicator of post-irradiation metabolic changes. Possible use in the diagnosis of radiation injuries is discussed. (C.H.)

6332 A/CONF.15/P/2507
TELETHERAPY WITH COBALT 60. Osolando J. Machado (Brazil). 20p.

The therapeutic advantages and disadvantages of supervoltage radiotherapy are summarized. The characteristics of radioisotopes for possible use as gamma sources are discussed. Clinical experiences with a cobalt-60 teletherapy unit are reviewed. (C.H.)

6333 A/CONF.15/P/2510
LA MEDECINE INDUSTRIELLE DANS LE CENTRE D'ETUDE DE L'ENERGIE NUCLEAIRE DE MOL. (Industrial Medicine in the Nuclear Energy Study Center at Mol.) M. H. Faes (Centre d'Etude de l'Energie Nucléaire, Brussels). 13p.

The aim of an industrial medical service is to maintain the health of the personnel in normal conditions and to treat personnel in the case of accidents or illnesses caused by the work. The first objective of a medical service is one of control, in which a thorough clinical, radiological, and laboratory examination is given to all prospective employees. This examination is described in detail. The discovery of professional illnesses is as fully described. The legal safeguards for a person accidentally exposed to radiation are discussed. (J.S.R.)

6334 A/CONF.15/P/2511
CONTRIBUTION À L'ÉTUDE DE LA PHOSPHOCAPTATION (P^{32}) AU NIVEAU DE LA THYROIDE DES SURRÉNALES ET DES TESTICULES APRÈS ADMINISTRATION DE L'ÉPIPHYSE-HORMONE. (Contribution to the Study of Phosphate Uptake (P^{32}) at the Level of the Thyroid, The Suprarenals, and Testicles after Administration of Epiphysis Hormone.) I. Negoŝcou, Al. Bojinescuu, Fl. Cocou, C. Petrescou, and A. Lupulescou (Inst. d'Endocrinologie, Bucharest). 4p.

The phosphorus uptake by several endocrine glands after the administration of epiphysis hormone was studied by a tracer technique. After ten days of daily injections of the hormone into male albino rats, the rats received an injection of P^{32}. The hormone was again given 6, 12, and 18 hours after the P^{32} injection. Some animals were killed 6 hours after the administration of phosphorus and the rest after 24 hours. The radioactivity of the epiphysis, hypophysis, thyroid, suprarenals, testicles, and seminal vesicles was determined. The results showed a functional inhibition of the phosphorus uptake in the thyroid, suprarenals, testicles, and seminal vesicles. A decrease in the phosphorus uptake by the hypophysis was also observed. (J.S.R.)

6335 A/CONF.15/P/2512
L'ACTION DES VITAMINES B_1 ET B_{12} AINSI QUE DE LA BENZEDRINE ET DU PHENOBARBITAL SUR LA FONCTION THYROIDIENNE ETUDIEE A L'AIDE DE L'IODE RADIOACTIF (I^{131}). (The Effect of Vitamins B_1 and B_{12} and Benzedrine and Phenobarbital on the Thyroid Function Studied with Radioactive Iodine (I^{131}).) A. Lupulescou, I. Négoescou, Al. Pop, and Fl. Cocou (Inst. d'Endocrinologie, Bucharest). 13p.

The effects of vitamins B_1 and B_{12} and benzedrine and phenobarbital on the normal thyroid function and on experimental goiters, obtained by an iodine-deficient diet in rats for 9 to 10 months, were studied. Five days before sacrificing the animals, the uptake of radioiodine was determined by administering to each rat 4 μc of I^{131} intraperitoneally. The determinations were made with a Geiger counter 4, 24, 48, 72, and 100 hours after the injection. After sacrifice, the thyroid, hypophysis, and suprarenals were removed. The uptake of I^{131}, the basal metabolism, the weight of the animals and of the thyroid gland, and the histologic structure were determined. The results showed that vitamin B_1 decreased the iodine uptake, and vitamin B_{12}, benzedrine, and phenobarbital increased it. In the rats with a iodine-deficient diet, vitamin B_1 and phenobarbital decreased the iodine uptake. Vitamin B_{12} and benzedrine increased the basal metabolism. Vitamin B_1 decreases the body and thyroid weight, whereas, phenobarbital has no effect. The histologic results are discussed. (J.S.R.)

CHEMISTRY

General

6336 A/CONF.15/P/24
COMPATIBILITY OF BERYLLIUM WITH OTHER METALS USED IN REACTORS. J. D. Baird, G. A. Geach, A. G. Knapton, and K. B. C. West (Associated Electrical Industries, Ltd., Aldermaston, Berks, Eng.). 20p.

The compatibility of beryllium was studied in the temperature range 500 to 700°C with a number of materials, which include copper, iron, nickel, niobium, tantalum, titanium, uranium, and Zircaloy. A more detailed study was made of the interaction between beryllium and uranium, and an assessment was made of the effect of natural or artificially produced protective films on the compatibility of these metals. (auth)

6337 A/CONF.15/P/165
STUDIES OF REACTIONS AT SOLID-LIQUID INTERFACES AND THE USE OF RADIOACTIVELY LABELLED SURFACE LAYERS. Lars-G. Erwall (Kungl. Tekniska Högskolan, Stockholm). 11p.

The sorption of S^{35}-labeled xanthate on the surface of different minerals was studied. Polished specimens were placed in contact with radioactive solutions under varying conditions for varying contact times. The specimens were autoradiographed, whereafter measurements of the photographic density of parts of the autoradiographs corresponding to the different minerals in the specimens give quantitative data for the sorption. Autoradiographs obtained in different experiments are shown. The sorption of different positive and negative ions on mineral and metallic surfaces in contact with solutions was studied by tracer techniques. Data for the kinetics are given for different concentrations and temperatures and also saturation data for the sorption. (auth)

6338 A/CONF.15/P/229
CANADIAN DEVELOPMENT WORK WITH MOVING-BED REACTORS FOR REDUCTION OF URANIUM TRI-

OXIDE AND HYDROFLUORINATION TO URANIUM TETRAFLUORIDE FOR SUBSEQUENT PRODUCTION OF METAL. F. W. Melvanin (Eldorado Mining and Refining Ltd., Ottawa). 13p. (AECL-639). $0.25(AECL).

Moving-bed shaft-type reactors are in use for the reactions $UO_3 + H_2 \rightarrow UO_2 + H_2O$ and $UO_2 + 4\ HF \rightarrow UF_4 + 2H_2O$. Each reaction is carried out in a simple vertical tube where gases enter countercurrently to the solid. The pilot plant producing 45 kg/day at the Port Hope Refinery is described. UO_3 is fed into the first reaction vessel in pellet form. (W.D.M.)

6339 A/CONF.15/P/298

A FIELD METHOD FOR THE DETERMINATION OF URANIUM IN NATURAL WATERS. G. H. Smith and T. R. D. Chandler (Chemical Research Lab., Teddington, Middx., Eng.). 11p.

A simple method was developed for field use in geochemical prospecting. It is based upon the formation, at a pH of about 6, of the yellow colored uranium-dibenzoylmethane complex which is extracted from the water sample with carbon tetrachloride. The organic phase is separated from the water and its color intensity compared visually with that of a set of standards. In this way it is possible to detect amounts of uranium down to 1μg of U_3O_8. The dibenzoylmethane is added to the water sample as a 0.5% w/v solution in a 1:1 v/v pyridine-water mixture containing 0.6% w/v ethylenediaminetetraacetic acid (disodium salt) to complex interfering metallic ions. Ascorbic acid is also added to the water sample to eliminate the interference otherwise caused by ferric iron. It was found that many waters contained organic matter that caused emulsification and orange-brown colors in the carbon tetrachloride layer. To remove this interference, several types of adsorbent material were examined including silica gel, activated alumina, kaolin, precipitated manganese dioxide and several grades of activated charcoal. Of these, certain grades of activated charcoal proved to be the most satisfactory. The adsorbent is added to the acidified water sample which is then filtered and neutralized with alkali before proceeding with the method. It was found that the addition of 2 vol. % of silicone fluid to the carbon tetrachloride helped to prevent emulsification, as does the addition of sodium chloride to the aqueous phase. (auth)

6340 A/CONF.15/P/300

THE REDUCTION OF URANIUM HEXAFLUORIDE BY CARBON TETRACHLORIDE. J. S. Nairn, D. A. Collins, and J. C. Taylor (United Kingdom Atomic Energy Authority, Cumb., Eng.). 12p.

A single stage method is described for converting UF_6 to UF_4. UF_6 dissolves in carbon tetrachloride at ordinary temperatures to form a reasonably stable solution. When heated to temperatures of 150°C and above, however, a rapid reaction takes place which is simply expressed as $UF_6 + CCl_4 \rightarrow UF_4 + Cl_2 +$ chlorofluoromethanes. Some excess CCl_4 is required to take the reaction to completion, and a molar proportion of 4 CCl_4:1 UF_6 is satisfactory. Apart from the UF_4, the products of the reaction are volatile even at ordinary temperatures and can be removed in a stream of warm air. The UF_4 product is in a form suitable for direct reduction by calcium or magnesium to uranium metal of high quality suitable for fuel element fabrication. (auth)

6341 A/CONF.15/P/303

CHEMICAL STUDIES OF CARBON DIOXIDE AND GRAPHITE UNDER REACTOR CONDITIONS. A. R. Anderson and J. Wright, ed. (Atomic Energy Research Establishment, Harwell, Berks, Eng.); H. W. Davidson (General Electric Co., Wembley, Eng.); R. Lind (United Kingdom Atomic Energy Authority, Sellafield, Cumb., Eng.); D. R. Stranks (Univ. of Leeds, Eng.); and C. Tyzack (United Kingdom Atomic Energy Authority, Culcheth, Lancs, Eng.). 102p.

The results of five chemical studies of graphite and CO_2 which have received attention in connection with compatibility in Calder Hall Reactors are presented. The thermal reactions between C and CO_2 below 600°C are explained in terms of surface oxide formation. Three successful techniques which have been used to reduce the rate of reaction between graphite and CO_2 at higher temperatures are described. The reaction between graphite and CO_2 under pile irradiation at temperatures up to 350°C is studied. The results from experiments conducted during startup of the first two Calder Hall Reactors are given. Experiments on the radiation-induced exchange reaction between $C^{14}O$ and CO_2 are described. (W.D.M.)

6342 A/CONF.15/P/304

THE CHEMISTRY AND METALLURGY OF NEPTUNIUM. H. A. C. McKay and M. B. Waldron (Atomic Energy Research Establishment, Harwell, Berks, Eng.), and J. S. Nairn (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). 22p.

Gram quantities of neptunium were isolated from process wastes. NpO_2 and Np_3O_8 were prepared by the ignition of precipitated Np(V) hydroxide, the former at high temperatures (600 or 1000°C) and the latter at lower temperatures (150 or 300°C) in air. Their stoichiometry and crystal structure were studied, as well as the decomposition of Np_3O_8 on heating. NpF_4 was prepared by heating NpO_2 to 600°C in a stream of HF and O_2, and its structure confirmed. Reduction of NpF_4 with excess Ca in an argon atmosphere yielded Np metal in 98.7% yield. The use of Fe(II) and N_2H_4 to reduce neptunium to the IV-state in nitric acid solution and of O_3 to oxidize it to the VI-state was studied. Electron transfer spectra due to Np(IV) complexes with nitrate, sulfate, and chloride and to Np(VI) complexes with nitrate and sulfate were observed in the ultraviolet. The threshold wavelengths fall in the order expected from the electron affinities and ionization potentials of the ions concerned. Correlations can be made with spectral changes at longer wavelengths due to complexing. No such changes could be found in the Np(V) spectrum between 400 and 1000 mμ over a range 1 to 8M in nitrate ion. The extraction of Np(IV) and Np(VI) from nitrate solutions by dibutyl carbitol and tributyl phosphate was investigated. Physical property measurements were carried out on 20 g of neptunium metal. These demonstrated the existence of three allotropic modifications α, β, and γ between 20°C and the melting point, 640 ± 5°C. The specific heat of the α phase over the range 60 to 200°C varies between 0.03 and 0.04 cal/g°C which gives a value for the atomic heat in excess of the theoretical Dulong and Petit value. The α phase has a Vickers hardness number of 355; the Meyer index and number are 2.19 and 458, respectively. (auth)

6343 A/CONF.15/P/328

ANALYSE ISOTOPIQUE PAR SPECTROSCOPIE D'EMISSION. (Isotopic Analysis by Interferential Spectrometry). J. Artaud and S. Gerstenkorn (Commissariat à l'Énergie Atomique, Paris), and

J. Blaise (Centre National de la Recherche Scientifique, Paris). 20p.

The principle of isotopic analysis by emission spectroscopy is discussed. The method is only valid for those elements where the isotopic displacement has a value twice as large as the length of the Doppler rays emitted by the source. The Fabry-Perot photoelectric spectrometer used for isotopic analysis is described briefly. The application of this method to the isotopic analysis of helium, lithium, lead, and uranium is given. (J.S.R.)

6344 A/CONF.15/P/338

LE THORON ET LES RISQUES ASSOCIES DANS LA MANIPULATION DES COMPOSES DU THORIUM. (Thoron and Hazards Associated with the Handling of Thorium Compounds.) J. Pradel and F. Billard (Commissariat à l'Énergie Atomique, Paris). 42p.

Thoron and its daughters are continually released from thorium compounds, and their radiations present a danger to persons handling the compounds. A study was made of various methods for the determination of thoron in equilibrium with ThA in the air. The danger presented by thoron in the immediate vicinity of Th sources in a plant extracting thorium from uranothorianite ores was evaluated. A comparison was made of a continuous and a discontinuous method for the determination of thoron alone in air. The determination of thoron and radon with a scintillation chamber is described in detail. The evaluation of the dangers associated with the handling of thorium ores and compounds showed that the maximum permissible concentration for thoron in equilibrium with ThA is 10^{-6} $\mu c/cm^3$ and is 10^{-10} $\mu c/cm^3$ for ThB in equilibrium with its daughters. (J.S.R.)

6345 A/CONF.15/P/471

SPECTROPHOTOMETRIC DETERMINATION OF URANIUM IN ORGANIC-SOLVENT SOLUTIONS. Z. I. Dizdar and I. D. Obrenović (Inst. of Nuclear Sciences "Boris Kidrič," Belgrade). 14p.

Results obtained by various methods and for different solvent solutions of uranium are tabulated. The values represent the average of 2 to 8 independent determinations. The accuracy of the results is satisfactory in all cases considered, except the hydrogen peroxide method which gives higher results up to 6%. A similar observation was reported for solutions containing dissolved organic substances when analyzed by the peroxide method. Only when applied to uranium solutions in ethyl acetate does the peroxide method yield satisfactory results. (auth)

6346 A/CONF.15/P/474

EXTRACTION OF THORIUM BY A MIXTURE OF ETHYL ACETATE AND ACETONE. Milutin Andjelković and Dragica Rajković (Inst. for Tech. of Mineral Raw Materials, Belgrade). 10p.

A method for extraction of thorium by a mixture of ethyl acetate and acetone, applicable to a wide range of thorium concentrations, was worked out. For this process quantities from 13 to 53 micrograms of thorium were used. The behavior of various cations and anions was examined, and a system for avoiding difficulties caused by zirconium was worked out. The method for determination of thorium is particularly efficient for materials with a low thorium content, using extraction by a mixture of ethyl acetate and acetone as separation method and the Thomason's colorimetric method for final determination. As the material contains larger quantities of thorium, the final determination can be done by the gravimetric method. Besides thorium, only uranium, zirconium, and bismuth were extracted among all the elements analyzed. To avoid difficulties caused by zirconium, the authors exploited its property to form complexes with tartaric acid which are not extracted. Uranium is extracted quantitatively, but during the determination of thorium by thorin it can be present in twenty times greater amounts. Bismuth does not interfere with the final determination. The method is simple, sufficiently rapid, and applicable to routine work. From materials with a complex composition, microgram quantities of thorium can be determined with an error usually below ± 5%. This method has been used for more than one year and has given satisfactory results. (auth)

6347 A/CONF.15/P/480

THE SYNTHESIS OF ^{14}C-LABELED α-METHYL-β-ALANINE FROM GLYCINE. I. Monković, P. Strohal, et al. (Inst. Ruder Bošković, Zagreb). 5p.

C^{14}-labeled α-methyl-β-alanine was synthesized, starting with glycine-2-C^{14} with an activity of 0.1 mc. (J.E.D.)

6348 A/CONF.15/P/482

SODIUM HYPOPHOSPHATE AS A REAGENT FOR THE SEPARATION OF THORIUM, ZIRCONIUM AND NIOBIUM. L. Kosta and L. Ravnik (J. Stefan Inst., Ljubljana, Yugoslavia). 11p.

A very selective procedure for the separation of niobium, zirconium, and thorium from most elements as well as from each other has been devised. It is based on the precipitation of these elements with sodium hypophosphate using titanium as carrier. The precipitation from 6 M hydrochloric acid is nearly quantitative. After eliminating other interfering elements, thorium is separated in the form of fluoride. Zirconium is coprecipitated as barium zirconium fluoride from a solution in which niobium was complexed with hydrofluoric acid. Niobium is finally isolated from the hydrofluoric medium as cupferrate. A detailed description of the procedures for the determination of the isolated ions is given. A liquid-liquid extraction system using mesityl oxide as solvent for separating niobium from the hydrochloric-hydrofluoric medium is described, and data for distribution coefficients are included. The advantage of this system over others found in the literature lies in that it requires a low concentration of the hydrofluoric acid. (auth)

6349 A/CONF.15/P/483

THE BEHAVIOUR OF RUTHENIUM IN SOLUTIONS OF SOME ORGANIC ACIDS. Š. Mesarić and M. Branica (Inst. Rudjer Bošković, Zagreb). 19p.

The behavior of ruthenium tetroxide in solutions of oxalic, citric, and tartaric acid was investigated. Absorption spectra at 250 to 700 mμ, polarographic half-wave potentials, and diffusion coefficients are presented. In addition, electrophoretic mobilities of ruthenium ions in solutions of oxalic, citric, and tartaric acid were investigated, as well as adsorption of ruthenium complexes on an ion exchanger at equilibrium conditions from solutions of various concentrations of organic acids. Spectrophotometric, polarographic, electrophoretic, and ion exchange results are compared, and the behavior of the ruthenium complexes in the various organic acids is discussed. (auth)

6350 A/CONF.15/P/550

AN IMPROVED METHOD FOR THE DETERMINATION

OF TRACE QUANTITIES OF PLUTONIUM IN WATER. J. Kooi, U. Hollstein, and M. Schlechter (Reactor Centrum Nederland, The Hague). 18p.

The method for the determination of trace quantities of plutonium in aqueous media based on the extraction of the cupferron-complex following a concentration step was examined in detail. It was found that bismuth phosphate may advantageously be used as the coprecipitating agent. Measurements of the extraction, using chloroform, of Bi, Fe, and Pu as cupferrates were performed. By properly adjusting pH, a good separation of bismuth and plutonium may be achieved. A substantial reduction in the amount of iron was found to be possible, reducing sample size and self-absorption losses in α counting. The yield of plutonium compares favorably with that of other methods. A detailed procedure is given. (auth)

6351 A/CONF.15/P/552

THE PREPARATION OF URANIUM DIOXIDE FUEL FOR A SUSPENSION REACTOR. M. E. A. Hermans (Reactor Centrum Nederland, Arnhem, The Netherlands). 13p.

By using a controlled precipitation from a homogeneous solution, it is possible to produce an ammonium diuranate which, after reduction in hydrogen at 1100°C and subsequent sintering in a hydrogen–water vapor atmosphere at 1700°C, results in a uranium dioxide powder with a specific surface smaller than 0.1 m^2/g and with a favorable particle size distribution. (auth)

6352 A/CONF.15/P/1003

PRODUCTION OF ZIRCONIUM FOR REACTORS. M. Becker, F. Endter, et al. (Degussa, Frankfurt a.M.). 11p.

The manufacture of reactor-grade zirconium from commercial zirconium chloride demands not only the reduction in hafnium concentration but also an almost complete removal of all other impurities. Results and some of the technical details of a process working on a pilot plant scale are given. While complying in its essentials with fundamentally familiar principles, this process differs in individual stages from hitherto published production methods. (W.D.M.)

6353 A/CONF.15/P/1098

A CARBIDE-IODIDE PROCESS FOR HIGH PURITY THORIUM. D. E. Scaife and A. W. Wylie (Commonwealth Scientific and Industrial Research Organization, Melbourne). 58p.

Thorium carbide can be used as a feed material for production of thorium metal filaments by a Van Arkel–de Boer-type process. Factors influencing the synthesis of carbide from oxide and the growth of thorium metal from carbide were studied and optimum conditions of growth established. Metal having a carbon, nitrogen, and oxygen content lower than the best material obtainable from a conventional metal feed can be produced at satisfactory rates and temperatures. A thorium iodide decomposition unit with carbide feed material involves processes which are highly efficient at separating from thorium all major metallic impurities except zirconium, hafnium, and uranium. A large group of these impurities is volatilized at the high temperatures needed for carbide formation. The residual impurities are then eliminated by one or other of the several exclusion processes operating in the iodide formation and decomposition bulb. Application of the process to larger-scale operation is briefly discussed. Finally, attention is drawn to the excellent decontamination from fission products possible with irradiated thorium materials. (auth)

6354 A/CONF.15/P/1147

CORROSION DE L'OXYDE DE BERYLLIUM. (Corrosion of Beryllium Oxide). J. Elston and R. Caillat (Commissariat à l'Énergie Atomique, Paris). 56p.

Data are presented on the volatilization of beryllium oxide in moist air. The corrosion rate of powder samples or sintered shapes of various densities is dependent on the temperature and water vapor concentration. Data on the corrosion of sintered beryllium oxide in pressurized water are also presented. At 250°C, under a pressure of 40 kg/cm^2, water is very slightly corrosive. Some data on corrosion in liquid sodium are given. (J.S.R.)

6355 A/CONF.15/P/1155

ETUDE DE QUELQUES ECHANGEURS MINERAUX UTILISABLES DANS L'EAU A HAUTE TEMPERATURE. (Study of Some Mineral Exchangers for Use in Water at High Temperature.) J. Huré, R. Platzer, and R. Bittel (Commissariat à l'Énergie Atomique, Paris); J. Fourré (Société le Carbone-Lorraine, France); and R. Wey (Univ. of Strasbourg). 45p.

The study of the use of ion exchangers at high temperatures was made with a view to the purification of water in reactors. Natural ion exchangers with mineral structures (clay of the montmorillonite type), natural mineral compounds so treated as to give them the properties of ion exchangers (activated graphite), and synthetic mineral compounds (zirconium phosphates and hydroxides and thorium hydroxide) were investigated. The preparation of the minerals is described, and the results obtained with them are discussed in detail. (J.S.R.)

6356 A/CONF.15/P/1234

SYNTHESIS OF ORGANIC MOLECULES TAGGED WITH CARBON 14 AND SULFUR 35. L. Pichat (Commissariat à l'Énergie Atomique, Paris). 9p.

After a brief account of the history of the expansion, at the Commissariat à l'Énergie Atomique, of the production of labelled organic compounds, a brief description of the preparation of some typical molecules is given. (auth)

6357 A/CONF.15/P/1279

A FEW HETEROGENEOUS ISOTOPIC EXCHANGE REACTIONS. S. Ionescu, I. Negoescu, and L. Gainar (Inst. of Atomic Physics, Bucharest). 17p.

The following partial reactions which are involved in the heterogeneous isotopic exchange may play an important part: diffusion phenomenon in the liquid phase, ion absorption on the crystal surface, surface interchange reaction, diffusion in the solid phase, and dissolution followed by a new crystallization of the precipitate. The contribution of each partial process to the total exchange phenomenon has been determined for the $ZnO–ZnSO_4$ system. The exchange between the Zn^{2+} ions of the insoluble oxide and the Zn^{2+} ions of the $ZnSO_4$ solution was studied at 0, 15, 25, and 35°C by adding Zn^{65} to the solution. (W.D.M.)

6358 A/CONF.15/P/1280

A SOLVENT EXTRACTION METHOD FOR Co^{2+}. Silvia Ionescu and Carmen Grigorescu-Sabău (Inst. de Physique Atómique, Bucharest). 8p.

A comparative investigation of the extraction of Co^{2+} and Co^{3+} ions in the presence of each other in neutral solution is reported. A more efficient separation method of these ions is proposed, the extraction of Co^{2+} ions as $(Co^{2+}Py_4)(SCN)_2$ with $CHCl_3$. The method can be used also with tracer quantities. The formation of the com-

plex was investigated by this solvent extraction method varying each of the components in quantity the other being in excess. In this way it was observed that the radiometric titration, with $SCNNH_4$ can be applied successfully to the quantitative determination of Co^{2+}. The equilibrium shift obtained at the titration with pyridine allowed the calculation of the chemical potential for the combination of cobalt with pyridine. (auth)

6359 A/CONF.15/P/1296
ETUDE DE LA STRUCTURE DE CERTAINES COMBINAISONS ANORGANIQUES À L'AIDE D'ISOTOPES RADIOACTIFS. NOTE II. RECHERCHES SUR LES ISOPOLYACIDES. (A Study of the Structure of some Inorganic Combinations by Means of Radioactive Isotopes). R. Ripan and G. Marco (Inst. de Chimie de l'academie de la R.P.R., Cluj). 15p.

By using radiochromatography and working in electrolytic solutions, the degree of condensation of sodium tungstate was determined quantitatively as a function of pH, concentration, temperature, and time. It was established that these factors play an important role in the formation of the isopoly compounds. It was shown that sodium paratungstate solutions behave differently when the synthesis was made by cold or hot processes. In the first case, there exists in the solution a heterogeneous system as a result of the decomposition of the paratungstate in the radio of 1:2. In the second case, the new solutions are homogeneous, but they evolve with time and after 20 hr result in a decomposition with a ratio of 2:1. (tr-auth)

6360 A/CONF.15/P/1306
L'ACIDE FLAVIANIQUE, UN RÉACTIF SÉLECTIF DU ZIRCONIUM. (A Radiochemical Method of Determination and Separation of Zr with Flavianic Acid). Tiberiu Născuţiu (Inst. de Physique Atomique, Bucharest). 8p.

The behavior of 50 ions in flavianic acid (1-oxy-2, 4-dinitro-7-naphthalene sulfonic acid) was studied, and it was found that in 5 to 7.5 M HCl only Zr and Hf precipitate. A series of experiments made to determine Zr in the presence of Be, Cu, Co, Ni, U, and the rare earths showed that none of these elements interferred with the determination. The method for the gravimetric determination of Zr is given. (J.S.R.)

6361 A/CONF.15/P/1325
NEW ANALYTICAL METHODS OF BERYLLIUM. Kenji Motojima (Atomic Energy Research Inst., Japan). 23p.

8-Hydroxyquinaldine (2-methyl-oxine) was found to be useful as an analytical reagent for the determination of beryllium. With this reagent, beryllium can be determined gravimetrically, volumetrically, spectrophotometrically, and even fluorometrically, as in the case of aluminum determination with oxine. One of the main advantages in these methods lies in the elimination of aluminum interference, which is common in usual beryllium determination. Consequently, it requires no preliminary and complete separation of aluminum and provides a simple and accurate analytical method for beryllium determination. (auth)

6362 A/CONF.15/P/1327
SOME PROBLEMS OF MANUFACTURING REACTOR GRAPHITE. Tetsuji Sawai, Masao Mizuta, et al. (Showa Denko Co., Japan). 34p.

Research work on the production of reactor graphite and factors involved were studied. Manufacturing problems related to the properties purity, density, anisotropy, diffusion length of thermal neutrons, and conditions of machining are discussed. (auth)

6363 A/CONF.15/P/1388
L'EMPLOI DES RADIOELEMENTS DANS L'ETUDE DES COEFFICIENTS DE DIFFUSION DES ELECTROLYTES DANS LES GELS. (The Use of Radioelements in a Study of the Diffusion Coefficients of Electrolytes in the Gels.) G. Cetini and F. Ricca (Univ. of Turin). 12p.

A report is presented on the results obtained in the experimental determination of the diffusion coefficients of phosphates in a gelatin gel. The measurements were carried out in a chemically homogeneous medium to rule out the perturbation caused by the presence of two distinct phases, which, as a rule, is a feature of the work on diffusion in gels. The experimental method adopted affords a determination of the values of the diffusion coefficients at various points in the gel and a means of following the development of the phenomenon as a function of time. (auth)

6364 A/CONF.15/P/1394
RAPID METHOD FOR URANIUM DETERMINATION IN ROCKS BY MEANS OF RADIOMETRIC MEASUREMENTS OF ^{234}Pa IN EQUILIBRIUM WITH EXTRACTED ^{234}Th. G. Alberti, C. Bettinali, et al. (Univ. of Rome). 8p.

Uranium in rocks can be determined by isolation and counting of one of the radioelements which is in radioactive equilibrium with uranium. Th^{234}, which can be determined by β counting of Pa^{234} in equilibrium with it, was used. Th^{234} can be easily separated from other β emitters, possibly in disequilibrium with uranium, by extraction through fractionation with hexone. This method is applicable to several types of rocks; also, it has the advantages over other methods of determining uranium at concentrations as low as 0.005% and of being quite rapid. (auth)

6365 A/CONF.15/P/1399
PREPARATION OF PURE URANIUM METAL IN THE C.N.R.N. A. Cacciari, R. de Leone, C. Fizzotti, and M. Gabaglio (Centro Nazionale per le Ricerche Nucleari, Ispra, Italy). 14p.

A pilot plant for the production of uranium metal from concentrates is described. The employed procedure can be divided into seven steps: nitric dissolution of the concentrates; solvent extraction of uranyl nitrate by TBP; ion exchange conversion from uranyl nitrate to chloride; wet reduction by zinc from U(VI) to U(IV); precipitation of sodium uranium fluoride ($NaUF_5$) with hydrated hydrofluoric acid; bomb reduction with magnesium; and melting, alloying, and casting. Operational data are discussed, and comparisons are made with other conventional methods. (auth)

6366 A/CONF.15/P/1408
INVESTIGATION OF BACKSCATTERED BETA RADIATION AND ANALYSIS OF SOLUTIONS AND ALLOYS. S. Abid Husain (Atomic Energy Commission, Karachi, Pakistan). 8p.

Beta particles are backscattered by various substances. The degree of backscattering is a function of atomic number. The maximum energy of the backscattered radiations also depends upon the atomic number of the backscattering material. It has been found that every element is capable of backscattering a certain maximum energy which is independent of the maximum energy of the incident beta radiations so long as E (max. incident) > E (max. backscattered). An empirical relation has been derived connecting the maximum energy of the backscattered radiations and the atomic number of the backscattering material. This knowledge has been used to

analyze the liquid solutions. The lower energy radiations backscattered from the solvent components have been cut out by a suitable absorber, and the radiations still coming out are due to the solute which backscatters the harder radiations. There exists a linear relation between the intensity of these backscattered radiations and the solute content. Barium acetate solution has been used, and the method makes it possible to determine over 1% Ba in the solution rapidly with a reasonable accuracy. The method is also extended for the determination of some relatively lower atomic number components. (auth)

6367 A/CONF.15/P/1418
METHOD FOR DIRECT FLUORIDATION OF URANIUM COMPOUNDS. Jovino D. Pedregal and Francisco Aguilar (Junta de Energia Nuclear, Madrid). 20p.

This method is designed to obtain uranium fluoride by treating some uranium compounds with gaseous ammonium fluoride; the salts used for this process must be such that they contain the uranium as the sole fixed element. The use of ammonium fluoride as the fluoriding and reducing agent affords the possibility of obtaining the uranium fluoride in a single stage, with the advantage that it is totally recoverable as verified by various types of condensers. The uranium compounds used have been, among others, ammonium uranate and uranyl nitrate. Some diagrams were drawn up from the results obtained showing the scheme of the process. Among the various salts used, some offer technological advantages, while others are chemically worth while, since stoichiometric conditions are achieved in less time at the same temperature. All the compounds did not behave in the same manner. A study was conducted of the problem of materials, as raised by the need to use ammonium fluoride at high temperatures. Among the various materials tried, graphite, fluorite, magnesium, and urania, as well as some linings, are listed. The results obtained were good, and nuclearly pure uranium fluoride can be prepared in this fashion. The technological aspect also was dealt with, and various types of ovens were tried: horizontal, vertical, discontinuous, semi-continuous, and continuous, with satisfactory results. (auth)

6368 A/CONF.15/P/1423
GREFFAGE DES POLYCONDENSATS SOUS L'EFFET DES RADIATIONS IONISANTES. (The Addition of Polycondensed Macromolecules Under the Action of Ionizing Radiation.) R. Mihail, J. Herşcovici, and B. Hlevca (Inst. de Recherches Chimiques, Bucarest). 14p.

A study was made of the behavior of the polycondensed macromolecules under the action of ionizing radiation (gamma rays of Co^{60}) and in the presence of various monomers. The polycondensed macromolecules studied were: polyethyleneterphthalate, the polyamides, the unsaturated polyesters, and cellulose acetate. As a monomer, use was made of acrylonitrile, styrene, methyl methacrylate, ethylene, etc. In order to facilitate the work, some monomers were tagged with C^{14}. A study was made of the rate of formation of the added copolymer, and an attempt was made at determining its position on the macromolecule. (auth)

6369 A/CONF.15/P/1424
CONTRIBUTIONS TO THE USE OF ORGANIC SOLVENT ELUANTS IN CATIONIC EXCHANGE. S. Ionescu, O. Constantinescu, D. Topor, and E. Gârd (Inst. of Atomic Physics, Bucharest). 12p.

The possibility of using a mixture of acetone with HCl and water as an actual eluant for several cations on resins is investigated. The behavior of Cu, Zn, Ce, La, uranyl, and Th cations on KU-2 and R-21 resins is discussed. (W.D.M.)

6370 A/CONF.15/P/1450
THE OXIDATION OF GROUPS IVA, VA AND VIA ELEMENTS IN CARBON DIOXIDE AND THE DEVELOPMENT OF OXIDATION RESISTANT ZIRCONIUM ALLOYS. W. G. O'Driscoll and C. Tyzack (United Kingdom Atomic Energy Authority, Culcheth, Lancs, Eng.); and T. Raine (Metropolitan-Vickers Electrical Co. Ltd., Manchester, Eng.). 98p.

A brief summary of the results of a preliminary survey of the oxidation resistance of the metals from Group IV, V, and VIa in pressurized carbon dioxide at 500°C is given, and the relative merits of these metals compared with stainless steel from the standpoint of neutron absorption cross section and oxidation resistance are discussed. Although stainless steel has substantial advantages over any of these transition metals on oxidation grounds, a zirconium alloy which could be used as a cannin, or core constructional material at 500°C would have considerable potentialities. Oxidation rates in carbon dioxide for various grades of zirconium in a range of temperatures and some data on rates in wet carbon dioxide are given. It is concluded that sponge-base material is unsuitable for use at 500°C, whereas iodide zirconium might be suitable. (auth)

6371 A/CONF.15/P/1453
DEVELOPMENTS IN THE ANALYTICAL SERVICE GIVEN TO INDUSTRIAL ATOMIC ENERGY. F. J. Woodman, T. G. Clinton, W. Fletcher, and G. A. Welch (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). 31p.

Some of the advances in reducing the time for analytical work which have been effected as a result of development work carried out in the analytical laboratories of the Industrial Group of the UKAEA are described. Continuous uranium monitors for raffinates based on a solvent extraction separation and an absorptiometric finish and for process streams based on "in line" gamma absorption measurement are discussed. For laboratory application instruments and techniques described include: A direct reading high resolution spectrograph for uranium isotopic analysis. Adaptions of instrumental techniques under high activity conditions. Use of gamma spectrometry for rapid, specific estimations on large numbers of biological samples. Use of gas chromatography in the analysis of corrosive complex gas mixtures. (W.D.M.)

6372 A/CONF.15/P/1459
THE DESIGN, CONSTRUCTION AND EQUIPMENT OF SOME HIGH ACTIVITY CELLS IN THE UNITED KINGDOM. J. E. Bown (Atomic Energy Research Establishment, Harwell, Berks, Eng.), and E. D. Hyam (United Kingdom Atomic Energy Authority, Sellafield, Cumb., Eng.). 127p.

The high-activity cells in six U. K. installations are described. The design, operation, and equipment of the cells are described in some detail. (W.L.H.)

6373 A/CONF.15/P/1466
SOME INFRA-RED STUDIES ON THE USE OF DEUTERIUM IN THE CARBOHYDRATE GROUP. M. Stacey, S. A. Barker, et al. (The University, Edgbaston, Birmingham, Eng). 15p.

A previous study of the infrared spectra of a large number of glucopyranose, mannopyranose, and galac-

topyranose derivatives revealed that absorption peaks in the region 960 to 730 cm^{-1} could be correlated with certain stereochemical features in the molecules. In particular, Type 2a absorption shown by all α-anomers of the sugars at ~825 to 844 cm^{-1} was attributed to the deformation of the equatorial $C_{(1)}$-H while the corresponding Type 2b absorption shown by β-anomers at ~890 cm^{-1} was attributed to the deformation of the axial $C_{(1)}$-H. The 1-deutero derivatives of D-glucose, D-galactose, D-mannose, D-arabinose, and D-xylose have now been synthesized, and their infrared spectra show that the deformation frequencies of the equatorial and axial $C_{(1)}$-H bonds do not occur in the region 960 to 730 cm^{-1} but in the range 1,380 to 1,270 cm^{-1}. Since a wide diversity of groups can be introduced at position 1 without appreciably increasing the small over-all frequency standard deviation of Type 2a and Type 2b absorption, it is concluded that a vibration of the whole grouping at $C_{(1)}$ is responsible for Type 2a and 2b absorption and that the frequency exhibited is dependent on the stereochemical configuration at $C_{(1)}$(i.e., α or β). The region 1,380 to 1,270 cm^{-1} offers a promising alternative method of differentiating α- and β-anomers of sugars. (auth)

6374 A/CONF.15/P/1468
THORIUM METAL PRODUCTION BY A CHLORINATION PROCESS. A. R. Gibson, J. H. Buddery, et al. (Atomic Energy Research Establishment, Harwell, Berks, Eng.) 12p.

The production of thorium metal from thorium oxide via a chloride route is described. The route is based on the formation in situ of anhydrous thorium chloride in an alkali chloride melt, the melt being maintained molten throughout the process. It consists of two stages: chlorination of a thoria–carbon mixture suspended in a fused alkali chloride bath to yield a melt of thorium chloride dissolved in alkali chlorides; and the electrolysis of this melt to produce thorium metal at the cathode. The chlorination stage of the process is more difficult technologically than the electrolysis stage. Basically, it comprises the reaction $ThO_2 + 2C + 2Cl_2 \rightarrow ThCl_4 + 2CO$. The variables affecting this reaction have been extensively studied, and from this study three different ways of carrying out this reaction have been developed. These are: chlorination of thoria suspended in a fused chloride melt by cylinder chlorine, using the carbon in the form of a shaped block, and iron chloride as a catalyst; chlorination of an intimate mixture of thoria and carbon suspended in a melt by cylinder chlorine, without a catalyst; and chlorination of thoria suspended in a melt by nascent chlorine liberated at a carbon anode surface, the anode itself serving as reducing agent. The relative advantages of these routes are discussed. (auth)

6375 A/CONF.15/P/1497
THE USE OF Ca^{45} FOR THE DETERMINATION OF EXCHANGEABLE CALCIUM IN SOILS CONTAINING APPRECIABLE AMOUNTS OF CALCIUM CARBONATE AND GYPSUM. M. A. Abdel Salam and S. Hashish (Egyptian Atomic Energy Commission, Cairo and National Research Centre of Egypt, Cairo). 18p.

The exchangeable Ca in the Egyptian desert soils which normally contain appreciable amounts of calcium carbonate and calcium sulfate is determined by equilibration with radioactive Ca^{45}. In order to standardize the method, a reference soil which is fully saturated with Ca is first used. The interference of $CaCO_3$ and $CaSO_4$ with the determination is checked, and the method is compared with some of the other ordinary chemical methods. The isotope equilibration method offers possibilities for quicker and more reliable determination, especially where $CaCO_3$ and $CaSO_4$ are present in the soil sample. The results obtained are reasonable and suggest the use of the equilibration method for routine analysis. (auth)

6376 A/CONF.15/P/1498
DETERMINATION OF CALCIUM AND MAGNESIUM CARBONATES IN SOIL. Fathi Amer (Alexandria Univ., Egypt). 6p.

For determining the alkaline earth carbonate content of calcareous soils by the present methods, calcium and magnesium carbonates are measured together and results are expressed as calcium carbonate equivalent. A new method has been devised for the determination of each compound separately. It involves the use of Ca^{45} and a cation exchange resin. The method is based on the dissociation of the carbonates when the soil is stirred with a cation exchange resin and water. Calcium and magnesium ions dissociated from the carbonates are adsorbed by the resin. Exchangeable and soluble ions, present in the soil, are also adsorbed by the resin. Dissociated calcium and magnesium are determined by substracting exchangeable plus soluble ions from those totally adsorbed by the resin. The determination of exchangeable calcium in calcareous soils has been made possible by the Ca^{45} equilibration method. Exchangeable magnesium is determined in sodium acetate soil extract. Soluble ions are estimated by analyzing the saturation extract obtained from a soil paste. Soil samples are shaken with excess of resin in 50-ml. open centrifuge tubes to allow the carbon dioxide to escape. After the dissociation of the carbonates, the resin is separated from the soil by washing the suspension through 82-mesh bolting cloth mounted on a Buchner funnel. Calcium and magnesium ions adsorbed by the resin are exchanged by leaching the resin with 2N HCl. Extracted calcium and magnesium are determined by titrating with versenate. The method has been tested on several calcareous soils from Egypt. (auth)

6377 A/CONF.15/P/1535
LA UBICACION DE LOS ACTINIDOS EN EL CUADRO PERIODICO. (The Position of the Actinides in the Periodic Table). Germán E. Villar (Univ. of Uruguay, Montevideo). 19p.

Generalization of the Bohr theory leads to a law of formation of extranuclear electronic configurations which are shown graphically. The table corresponds to a natural classification of the elements which, except for slight variations, are grouped vertically in the same manner as in Mendeleev's periodic table. The elements are arranged horizontally in the order of the energy levels successively occupied by the electrons. Thus, the first period consists of hydrogen, helium, lithium, and beryllium, whose electronic configurations contain electrons in the Ks and Ls levels. Analysis of the law of formation of electronic configurations leads to the conclusion that the lanthanide series consists of lanthanum and the 13 elements following it. The electronic configurations of the series are of the type Nf^nPs^2 (n = 1 to 14). The actinide series is made up of actinium and the 13 elements following it. The electronic configurations of the series are of the type Of^nQs^2 (n = 1 to 14). It will be necessary to correct the present arrangement of the periodic table by inserting the

lanthanide series between barium and lutetium and by placing the actinide series between radium and element 103. The scandium group IIIa should comprise the elements scandium, yttrium, lutetium, and element 103 instead of the present composition of scandium, yttrium, lanthanum, and actinium. (auth)

6378 A/CONF.15/P/1568(Rev. 1)
SEPARATION OF TRACES OF RARE EARTH IN URANIUM BY IONIC EXCHANGE. Heriberto A. Braier (Comisión Nacional de Energía Atómica, Buenos Aires). 8p.

A solution of uranyl ion, with traces of europium, in a sulfuric medium is passed through a bed of cationic resin, in such a way that the anionic complex of the uranyl is let through and the rare earth retained. The remainder of the uranium is washed with a sulfuric acid solution, and the rare earth is subjected to elution by hydrochloric acid. The final determination is made by spectrography. The fixation of europium by the resin and its subsequent elution is continued by adding Eu^{154}, which acts as a tracer. This method is promising for the determination of traces of the rare earths in Uranium because it is simpler than those described in the literature. (auth)

6379 A/CONF.15/P/1576
A STUDY OF A NEW ELECTROLYTIC CARRIER FOR THE POLAROGRAPHIC DETERMINATION OF URANYL ION. Carlos J. Sambucetti and Aldo Gori (Comisión Nacional de Energía Atómica, Buenos Aires). 25p.

The polarographic behavior of the complex formed between the uranyl ion and the disodium salt of 1,2-dihydroxybenzene-3,5 disulfonic acid is reviewed, and the most adequate conditions for the analytic determination of the uranium present in this medium are established. The electrode reaction is reversible in the range between pH 2 and pH 3.5. The half-wave potential varies parallel to the pH; its values range from 0.222 to 0.243 volts, as measured against the calomel electrode, with a "tiron" concentration of 0.05 M. One electron intervenes in the reduction of the complex. The possible electrode reaction is indicated. (auth)

6380 A/CONF.15/P/1578
RAPID DETERMINATION OF BERYLLIUM IN BERYL MINERAL. J. L. Huguet and C. L. Bamberger (Comision Nacional de Energía Atomica, Buenos Aires). 7p.

A study was made of the attack of mineral beryl with sodium carbonate and of the beryllium determination by the direct precipitation produced by the attack, in which no previous separation (including that of the silica) has been made. The conclusion is reached that, provided some precautions are observed, the technique remains applicable, markedly reducing the time usually consumed by the conventional method. (auth)

6381 A/CONF.15/P/1580
GRAVIMETRIC DETERMINATION OF SILICA IN FLUORINE CONTAINING BERYLLIUM OXIDES. J. Luis Huguet (Comision Nacional de Energia, Atómica, Buenos Aires). 5p.

A study is made of the applicability of the SCHERNK and ODE method to the gravimetric determination of the silica content of technical grade beryllium compounds which contain some fluorine by reason of their origin. It is found that the method gives good results in the range for which it has been tried (silica contents of some 1%). (auth)

6382 A/CONF.15/P/1581
DETERMINATION OF THORIUM IN LOW GRADE ORES (FROM 0.01% TO 1%). Antonio A. Suñer (Comision Nacional de Energía Atómica, Buenos Aires). 26p.

A method is described for the determination of Th in low-grade ores. The analytical procedure used for interference separation has a separation factor (quotient of the amount of interference before and after using the procedure) of 10^4. This consists of making the Th insoluble with hydrofluoric acid, digesting by CO_3Na_2, extracting the Th with ethylic ether, precipitation as an iodate in an oxalic acid medium with a silver carrier ion, and spectrophotometric measurements with S-alizarine. The complete recovery of Th, in each of the steps of the analytical process, has been verified, using Th^{234}, as well as by spectrophotometry and/or gravimetry. The method was applied to the analysis of some minerals, with satisfactory results. (auth)

6383 A/CONF.15/P/1582
DETERMINATION OF FLUORINE IN BERYLLIUM COMPOUNDS. Juan Luis Huguet (Comisión Nacional de Energía Atómica, Buenos Aires). 10p.

A study was made of the applicability of titrimetric methods to the macro- and microdetermination of fluorine in beryllium compounds. A study is presented of the effect of various factors on the separation of fluorine by distillation, and a technique is designed which affords means of obtaining distillates having characteristics compatible with the application of the above mentioned titrimetric methods. (auth)

6384 A/CONF.15/P/1587
THE DISSOCIATION OF ORGANIC COMPLEXES OF PLUTONIUM IN ORGANIC MEDIA. M. Taube (Inst. of Nuclear Research, Warsaw). 5p.

Possible mechanisms of dissociation of organic complexes of plutonium in organic media are considered, particularly in connection with the possible role of such dissociation in mechanisms of extraction from water to organic solvents. Studies of migration in electrical fields were used to investigate the dissociation of such organic complexes as those with iso-butyl-methyl-ketone, tributyl phosphate, tetrabutylammonium nitrate, furfural, cyclohexanol, and acetone, in such media as the above solvents themselves, together with chloroform, carbon tetrachloride, and benzene. Apart from free migration studies, particular attention was paid to the use of paper electrophoresis for studying dissociation of complexes. Suitable apparatus for these studies is described, involving continuous automatic radiometric plutonium estimation on the electropherograms. Results show, among other things, the relatively pronounced dissociation of complexes of plutonium with organic compounds containing carbon–oxygen bonds, but less pronounced dissociation in other cases. (auth)

6385 A/CONF.15/P/1594
STUDIES ON THE CHEMISTRY OF SESQUIVALENT AND QUADRIVALENT URANIUM IN ORGANIC SOLVENTS. B. Jezowska-Trzebiatowska, A. Bartecki, M. Chmielowska, H. Przywarska, T. Mikulski, K. Bukietynska, and W. Kakołowicz (Polish Academy of Sciences, Wroclaw, Poland). 27p.

An attempt was made to tackle the problem of the electron structure and molecular state in various solvents of the uranyl and tetravalent uranium compounds from various aspects to obtain further data relative to the electron structure manifested by their complex forming properties and oxidation-reduction reactions. The structure of the uranyl ion is studied by observing the behavior of uranyl nitrate in organic

solvents. The absorption spectra method was used in the investigations. (W.D.M.)

6386 A/CONF.15/P/1596
REDUCTOMETRIC DETERMINATION OF METALS IN NON-AQUEOUS MEDIA. J. Minczewski, S. Kołyga, and L. Wódkiewicz (Polish Academy of Sciences, Warsaw). 8p.

Chromous acetate in dioxane solution was used as a reducing agent in non-aqueous media. The method was applied for the determination of uranyl nitrate in a solution of ethyl alcohol and for the determination of copper and vanadium after extraction with chloroform solution of 8-hydroxyquinoline. Good reproducibility and accuracy were obtained in concentrations of about 0.2 mg/ml. (W.D.M.)

6387 A/CONF.15/P/1600
CHEMICAL SPECIFICITY OF CATION EXCHANGE. I. CHARGE AND RADIUS EFFECTS WITH POLY-AMINO COBALTIC COMPLEXES. Bahattin Baysal (Univ. of Ankara). 13p.

Data are presented for the cation exchange equilibria in replacing La^{3+} from the cation resin Dowex-50 for five cobalt(III) complexes, three of tripositive charge (the trisethylenediamine complex, the hexamino, and the cisbisaquotetramino), on dipositive (the pentamino-chloro) and one unipositive (the tetraminöoxalate). The studies extended over a range of mole fraction of cobalt complex from 0.05 to 0.85. (W.D.M.)

6388 A/CONF.15/P/1671
NEW AND IMPROVED METHODS OF ANALYSIS OF SOME NUCLEAR RAW MATERIALS. V. T. Athavale, S. Banerjee, G. K. Belekar, N. Mahadevan, L. M. Mahajan, M. N. Nadkarni, Das M. Sankar, H. D. Sharma, A. K. Sundaram, M. Sundaresan, N. R. Thakoor, M. M. Tillu, M. S. Varde, and Ch. Venkateswarlu (Atomic Energy Establishment, Trombay, India). 15p.

A brief review is presented of the new and improved methods developed, in the Trombay laboratory during the past few years, for the analysis of minerals and ores for U, Th, Be, Nb, and Ta present in macro and micro amounts. Uranium and thorium determinations were also required in uranium and thorium crudes, intermediates, and pure thorium nitrate samples. (W.D.M.)

6389 A/CONF.15/P/1672
SEPARATION OF HAFNIUM FROM ZIRCONIUM BY SELECTIVE REDUCTION OF ZIRCONIUM TETRACHLORIDE WITH ALUMINIUM. Brahm Prakash and C. V. Sundaram (Atomic Energy Establishment, Trombay, India). 12p.

Thermodynamic calculations indicate that the formation of the di- and trichlorides of zirconium by aluminum reduction of gaseous zirconium tetrachloride is a highly feasible reaction. Although no reliable thermodynamic data on the free energy of formation of the lower chlorides of hafnium are available, the general behavior of transition elements suggests that as the atomic number increases, their lower valency compounds become increasingly unstable. In that case, reduction of the mixed tetrachlorides should yield the comparatively nonvolatile lower zirconium chlorides leaving the hafnium tetrachloride mostly unchanged. This investigation was undertaken to examine the feasibility of this process. The results indicate that at temperatures in the range 300° to 400°C, the method provides an effective means of hafnium removal for obtaining reactor-grade zirconium. Theoretical considerations and the process details are discussed. (auth)

6390 A/CONF.15/P/1675
ETUDE DE L'ETAT VALENCIEL DE L'I^{131} PRODUIT PAR IRRADIATION DE L'ACIDE TELLURIQUE. (Research into the Valence of the Iodine 131 Produced by Irradiating Telluric Acid). R. Constant (Centre d'Etude de l'Energie Nucléaire, Brussels). 11p.

I^{131} can readily be obtained by irradiating H_6TeO_6, dissolving the target in dilute H_2SO_4, and distilling once. The product thus obtained is radiochemically pure. During this operation, the iodine present in the distillate is recovered as I^0 and I^-, and it is often noted that only traces of iodine remain in the solution. On the other hand, the first tests made tended to show that the iodine appeared with a positive valence when the target was placed in solution, so that there was a dismutation or reduction phenomenon which had to be clarified. It was confirmed, by various methods, that I^{131} was present, chiefly as IO_3^-. It was shown that irradiation reduced the TeO_4^{2-} ions to their elemental state. The presence of this elemental tellurium provides a means of reducing the iodates and of distilling the iodine. This shows that the release of I^{131} during the distillation is easier if the target is irradiated for a longer time. (auth)

6391 A/CONF.15/P/1683
PHENOMENES D'ADSORPTION D'ANIONS AUX BENTONITES. (Anion Adsorption Phenomena on Bentonites). Yolande Hendrickx (Univ. of Ghent). 15p.

A study of ion adsorption phenomena on bentonites was made with the help of radioactive tracers. Bentonite consists principally of montmorillonite. The experiments were made with Cr^{51}-labeled Na_2CrO_4 and I^{131}-labeled $NaIO_3$. The adsorption for sodium chromate was determined for a series of concentrations, and the results are graphed. Negative adsorption was noted for sodium iodate. The negative adsorption was interpreted as a result of the fact that H-bentonite retained a certain amount of water which was inaccessible to $NaIO_3$, causing an increase in the concentration of the iodate solution with respect to the standard solution. The results are tabulated. (J.S.R.)

6392 A/CONF.15/P/1702
ECHANGES ISOTOPIQUES ET STRUCTURE DU PHOSPHATE TRICALCIQUE. (Isotopic Exchanges and Structure of Tricalcium Phosphate.) A. Baudrenghien, H. Brasseur, and J. Govaerts (Univ. of Liège). 49p.

A detailed study was made of the isotopic exchange reaction of calcium between a calcium chloride solution and a tricalcium phosphate precipitate and of phosphorus between disodium phosphate solution and a tricalcium phosphate precipitate. The results showed a very marked difference in the behavior of the calcium ion and the phosphoric ion. The determination of the crystalline constituents by an x ray spectrographic study and the study of the ion movements by chemical methods have shown the reason for this difference. It was concluded that the hydrated tricalcium phosphate, in contact with calcium chloride solutions, undergoes a decomposition reaction by hydrolysis and an addition reaction with calcium chloride. Hydrated tricalcium phosphate, hydroxylapatite, and chlorapatite are not distinct crystalline entities, but form a ternary solid solution in which the composition varies according to the experi-

mental conditions. The final composition of the solid phase is, however, the same. (J.S.R.)

6393 A/CONF.15/P/1703
PHENOMENES D'ADSORPTION A DES PRECIPITES DE $BaSO_4$ ET A DE LA POUDRE DE VERRE JENA 16 III, MESURES AU MOYEN D'ISOTOPES RADIOACTIFS. (The Use of Radioactive Isotopes for the Measurement of the Adsorption Phenomena Observed with $BaSO_4$ Precipitates and Iena 16 III Glass Powder.) W. Van Den Heuvel (Univ. of Ghent). 10p.

A tracer technique was used to study adsorption phenomena on $BaSO_4$ precipitates and glass powders of Jena 16 III. The specific surface of the $BaSO_4$ was measured and found equal to 0.5 m^2/gm. Exchange adsorption between precipitates and solutions of $BaCl_2$, $BaBr_2$, $Ba(NO_3)_2$, and $BaSO_4$ using labeled Ba was investigated. It was shown that there is an exchange adsorption not only on the surface of the substances, but also within their crystal lattice. A linear relation was found for the gx/cv values, where g is the amount of precipitate, x is the volume adsorbed, c is the concentration of the solution once equilibrium is reached, and v is the volume of the solution. This linear relation was confirmed by exchange adsorption studied with $Pb(NO_3)_2$, $CaCl_2$, NaCl, CsCl, and Na_2CrO_4. The specific surface of the glass powder was 510 cm^2/gm. The adsorption isotherms for NaCl and CsCl were determined, and they corresponded to the Lange and Berger isotherm. No Na_2CrO_4 adsorption could be measured. (J.S.R.)

6394 A/CONF.15/P/1718
ANALYSIS OF URANIUM, THORIUM AND ZIRCONIUM. Gy. Almássy, M. Ördögh, and A. Schneer (Central Research Inst. for Physics, Budapest and Loránd Eötvös Univ., Budapest). 18p.

Considering the physico-chemical conditions for tributyl phosphate uranium extraction, the optimum nitrate concentration of the aqueous phase in which uranium separation by single extraction amounted virtually to 100% was determined. The extraction was carried out in tributyl phosphate–petrol solution and the uranium re-extracted in a dilute ammonium carbonate solution. The uranium content was determined by reduction of U(VI) to U(IV) and subsequent oxidizing with Fe(III) which can be measured by the light absorption of α,α'-dipyridyl complex equivalent to uranium at 500 mμ wavelength. As to the chromatography of thorium it has been found that using the solvent indicated in the literature, thorium produces an elongated strip on a cellulose column or on paper. This spot becomes more compact by increasing the acid and water content of the solvent. The optimum composition of the solvent was determined: 8 N nitric acid was shaken with the same quantity of ether and after separation of the two phases the ether phase was used. Among the colorimetric determinations of thorium the thoron method was improved for the analysis of ores by reducing Fe(III) in ascorbic acid. The sensitivity of the method increases by about 70% by the addition of methyl alcohol. Zirconium and hafnium can be separated selectively in amygdalic acid. The precipitate, containing 0.2 to 3 mg zirconium is dissolved in excess concentrated sulfuric acid and the amygdalic acid, bound to the zirconium quantitatively, can be oxidized into carbon dioxide and water with sodium bichromate solution. In the presence of 2 to 20 mg of zirconium the oxidation can be carried out in excess $KMnO_4$ in a fairly caustic medium. The vivid yellow zirconium morin complex fluorescing a green glow in UV light is suitable for the photometric determination of zirconium. Measurements can be carried out between 420 to 470 mμ. (auth)

6395 A/CONF.15/P/1731
THE SIGNIFICANCE OF HUMUS IN THE GEOCHEMICAL ENRICHMENT OF URANIUM. A. Szalay (Hungarian Academy of Sciences, Debrecen). 14p.

Systematic investigations clarified the phenomenon, and convincing experiments demonstrated that humic acids are responsible for the enrichment of uranium. A general outline of these experiments is given including the latest results. The first experiments showed that lignite, peat, and other similar decayed plant substances adsorb uranium very quickly from an aqueous solution in the pH range of $3 < pH < 7$. The adsorption on a given peat preparation shows an adsorption isotherm which can be treated according to the formalism of Langmuir. The adsorption property of a peat preparation can be expressed quantitatively by two numerical constants: a saturation capacity and an enrichment factor. The saturation capacity is about 1 milliequivalent/UO_2^{2+}/gr of peat, and the enrichment factor is about 1:10000 at about pH ~ 5. Peat contains a large proportion of humic acid. Experiments showed that these components are responsible for the adsorption, and the phenomenon itself is a cation exchange process, in which the H^+ ions of the humic acids are exchanged for UO_2^{2+} ions. Tracer experiments showed that Th^{4+} ions are reversibly adsorbed in the laboratory experiment, i.e., they are steadily dynamically exchanged with the Th^{4+} ions in the aqueous phase. A comparison of the enrichment factor of 1:10000 with the usual concentration of uranium in natural waters and bioliths demonstrates good agreement. When peat is in contact with water, at a pH between 5 and 7, a U concentration of 10 mg/ton water is sufficient to cause an enrichment of 1:10000, i.e., 100 gr U/ton peat. Humic acids are the most important agents in nature responsible for the enrichment of U in peat. Though some other special chemical environments may be responsible for a chemical precipitation on some places of limited extension and for the origin of further secondary concentration of U, the general importance of humus in the geochemical enrichment of U in nature can not be doubted. (auth)

6396 A/CONF.15/P/1810
SEPARATION OF TECHNETIUM FROM RHENIUM BY PAPER ELECTROPHORESIS. Rodrigo Alberto Guedes de Carvalho (Comissão de Estudos da Energia Nuclear, Porto, Portugal). 5p.

The electrophoretic separation of rhenium from technetium was achieved by reduction of Tc (VII) to Tc (IV) which is cationic or does not migrate, while Re (VII) is not affected by the reductant and maintains its anionic character. Among several reductants studied buffered solutions of hydrazine hydrate and sulfate (pH = 8 to 9) and hydriodic acid permitted very good and rapid separations of the two elements. (auth)

6397 A/CONF.15/P/1814
NEW SPECTROPHOTOMETRIC METHOD FOR THE DETERMINATION OF URANIUM. Fradsto da Silva and Legrand de Moura (Comissão de Estudos da Energia Nuclear, Lisbon). 17p.

A method is described for the determination of small amounts of U_3O_8 making use of the displacement of the lacto-form to the quinone-form of Rodamine B by the action of uranyl salts of carboxylic acids soluble in benzene. The color is estimated spectrophotometri-

cally, the Beer law being perfectly followed for 5 to 80 γ/ml of U_3O_8. The best operating conditions are selected and the main interferences considered. These are specially Fe, Sn, Mn, Sb, and Tl. Since Cu and Al do not interfere, the classical scheme of separation may be followed. Some analysis results of poor uranium minerals are shown in comparison with the results obtained by other methods. (auth)

6398 A/CONF.15/P/1818
BEHAVIOUR OF CATIONIC EXCHANGE BETWEEN METALS AND ELECTROLYTIC SOLUTIONS.
F. Barreira (Comissão de Estudos da Energia Nuclear, Lisbon). 15p.

Metals and ionic solutions labelled with radioisotopes were used on the experimental study of cationic exchange. Experiments were performed with metallic zinc and silver, contacting with solutions of its own salts and solutions of other metal salts. Solutions of zinc sulfate and sodium sulfate and chloride were used with activated metallic zinc; cupric and zinc salts were employed with activated metallic silver. In all the systems studied the exchange of cations was observed with the only exception of metallic silver in contact with solutions of zinc salts. Results are discussed according to a proposed general theory of cationic exchange. On the system silver/cupric sulfate the influence of the surrounding gaseous atmosphere was studied. There is no difference when experiments are performed using argon instead of air.

6399 A/CONF.15/P/2026
THE DEVELOPMENT OF METHODS OF REMOTE CONTROL OF OPERATIONS AT RADIOCHEMICAL LABORATORIES OF THE U.S.S.R. ACADEMY OF SCIENCES. G. N. Yakovlyev and V. B. Dedov (Academy of Sciences, U.S.S.R.). 22p.

One of the simplest designs of protective equipment and an automatic program device based on this principle are given. The equipment described, three-section lay-out of laboratories, and strict control over observance of safety rules ensure cleanliness in laboratories and protection of personnel from radiations. Application of the latest principles and means of process automation is of great importance for the development of remote-control equipment. This application, however, requires a preliminary estimation of expenditures. Rational approach to the solution of this problem has made it possible to work out a general type of laboratory equipment, which satisfies definite requirements. Various methods of satisfying these requirements and peculiarities of such equipment are discussed. Principles and diagrams of automation of the most labor-consuming separation processes based on precipitation, extraction, and chromatography methods are given. (auth)

6400 A/CONF.15/P/2042
CORROSION BEHAVIOUR OF STRUCTURAL METALS IN IONIZED AIR. I. V. Shatalov and V. A. Nikitina (U.S.S.R.). 19p.

The results of investigations on the corrosion behavior of copper, aluminum, carbon steel, and stainless steel in air ionized by alpha particles are reported. The influence of relative humidity and radiation intensity was studied. (W.D.M.)

6401 A/CONF.15/P/2050
OBTAINING CHEMICALLY PURE STRONTIUM, BARIUM, MAGNESIUM AND CALCIUM. A. N. Volsky, N. V. Viatkina, et al. (U.S.S.R.). 22p.

The results of research on the preparation of chemically pure strontium, magnesium, calcium, and barium are presented. On the basis of information available and experimental work, a method of preparation of strontium through reduction of its oxide was chosen. Rough metal thus produced was subjected to a repeated sublimation with the condensation of the metal on a cooled condenser. To prepare pure magnesium, a method of refining commercial magnesium was chosen. Magnesium was sublimated and precipitated on the walls of the apparatus. The magnesium was precipitated as an even layer. It was found that impurities are distributed irregularly along the height of the condensate, and its upper part is contaminated with them to a greater extent. Data are given on the results of repeated magnesium sublimation operations and on the effect of temperature on the degree of magnesium purification. To produce pure calcium, a sublimation method of refining commercial metal was tested; the latter was obtained by electrolysis, or by metallo-thermic reduction. Data are given on refining calcium by means of a single and repeated sublimation. It is found that the impurities of the condensate are distributed irregularly. The effect of temperature on the degree of calcium purification was investigated. To prepare pure barium, a method of oxide reduction with refining of the rough metal by repeated distillation was tested. (auth)

6402 A/CONF.15/P/2051
RAFINIROVKA BERILLIYA I DRUGIKH METALLOV KONDENSATSIEI NA NAGRETYKH POVERKHNOSTYAKH. (Refining Beryllium and Other Metals by Condensation on Heated Surfaces.) K. D. Sinel'nikov, V. E. Ivanov, et al. (U.S.S.R.). 19p.

The results from a new method for preparing very pure metals and applications of this method for refining beryllium, iron, manganese, chromium, etc., are outlined. The method differs from the conventional methods of vacuum distillation of metals in that the surfaces heated to high temperatures are used as condensers. The possible kinetics of the process of removing slight impurities during the condensation on surfaces with a high temperature points to the possible refining of metals from impurities whose vapor pressure differs from that of the base metal. An illustration is given of refining beryllium from an admixture of manganese and aluminum, as experimental proof of the procedure. The data obtained indicate that it is possible to obtain beryllium 99.98% pure at a commercial scale processes. Similar data are given with respect of iron and manganese. Iron crystals obtained by condensation on a surface with a temperature of 1150°C are 99.996% pure. These iron samples are the purest obtained in laboratory conditions. A single distillation of ferromanganese produces a manganese condensate 99.96% pure. Distillation of chromium is given as an example to prove the necessity of taking into account additional factors affecting the purity of the metal to be produced. These factors are the formation of volatile suboxides during the evaporation and the reduction of "activity" of some elements in the presence of slight impurities. Further possible applications of the new method for refining metals from slight impurities are discussed. (auth)

6403 A/CONF.15/P/2062
O FLOTIRUEMOSTI NASTURANA IZ ISKUSSTVENNYKH MINERAL'NYKH SMESEI I IZ RUD. (Flotation of Pitchblende from Synthetic Mixtures and Ores). M. A. Eigeles, L. A. Grekulova, et al. (U.S.S.R.). 19p.

The results of investigations illustrating the funda-

mental possibility of obtaining satisfactory grades and recoveries of pitchblende from synthetic mixtures and ores by flotation are presented. Naturally activated quartz and feldspars float just as readily as pitchblende and have optimum flotation pH values close to that of the uranium mineral. For this reason the selectivity of flotation of pitchblende from its gangue minerals is ordinarily very low. Pitchblende has been floated selectively from synthetic mixtures and ores by the combined adjustment of various factors. With two samples of quartz-feldspar pitchblende ores flotation gave concentration ratios of 32 and 18 with uranium recoveries amounting to about 90% of its content in the flotation feed. Alkyl acid phosphates possess distinct collecting properties with respect to pitchblende and other uranium oxide minerals. The flotation of uranium ores by alkyl phosphate derivatives features a number of peculiarities. A modifying agent greatly increases the selectivity of separation of pitchblende from the gangue. Flotation of a deslimed pitchblende ore with a complex gangue resulted in a very high recovery of unlocked pitchblende grains at a high concentration ratio (50 and over). Flotation of finely disseminated pitchblende-uranium black ores almost in all cases gives a high percentage of waste tailings (assaying less than 0.02% uranium). (auth)

6404 A/CONF.15/P/2065

FLOTABILITY OF BERYL. M. A. Eigeles and I. T. Levlush (U.S.S.R.). 18p.

Data on the flotation of beryl, feldspar, and quartz, unactivated and activated by polyvalent metal cations, are presented. The effect of the interaction of these minerals with iron, calcium, and magnesium compounds on their flotabilities was investigated in relation to the conditions of preparing these minerals for flotation. The influence of a number of factors and reagents on the flotation of beryl, quartz, and feldspar was examined. The fundamental conditions for the flotation of beryl from its ores are set forth. The results of dressing obtained in floating several types of beryl ores are given, these types include quartz-feldspar, micaceous, and mica-quartz-feldspar ores. A procedure was developed for finishing concentrates by flotation. It is indicated that the results achieved in the laboratory were confirmed by pilot plant tests. (auth)

6405 A/CONF.15/P/2067

EKSPERIMENTAL'NYE ISSLEDOVANIYA USLOVII PERENOSSA I OTLOZHENIYA URANA GIDROTERMAL'NYMI RASTVORAMI. (The Experimental Investigation of the Conditions of Uranium Transport and Deposition by Hydrothermal Solutions). R. P. Rafal'skii (U.S.S.R.). 34p.

The investigations were carried out in accordance with the up-to-date concept on the transport of hexavalent uranium under hydrothermal conditions and its precipitation as a result of reduction. The study of the stability of sodium uranyl tricarbonate showed that it is decomposed with precipitation of uranates at a temperature of about 100°C. It has been found that hexavalent uranium is reduced by hydrogen sulfide both in acid sulfate and carbonate solutions at elevated temperatures. In carbonate solutions uranium is reduced even at room temperature. In this case the reaction proceeds in a neutral or even slightly acid medium in the presence of H_2S and CO_2. In excess of H_2S the reaction results practically in complete reduction of hexavalent uranium. At an elevated temperature and pressure uranium is reduced and precipitated from uranyl sulfate solutions by pyrite, chalcopyrite, galena, siderite, hornblende, or organic components of carbonaceous shales. The end product of the reduction is usually crystalline uraninite. The data obtained indicate the possibility of hexavalent uranium being transported by hydrothermal solutions and deposited as a result of reduction process. At the same time the values of solubility of freshly precipitated uranium dioxide at elevated temperatures determined experimentally make it possible to assume that under hydrothermal conditions uranium could migrate in its tetravalent form as well. (auth)

6406 A/CONF.15/P/2099

K RESHENIYU STRUKTURY U_3O_8. (A Contribution to The Solution of the Structure of U_3O_8). B. Chodura and J. Malý (Czechoslovakia). 23p.

The structure of U_3O_8 is discussed. Three cells alternate in the structure of U_3O_8—one orthorhombic and two monocline ones, which are close to being orthorhombic, as was determined by the x-ray method for a rotating monocrystal. This arrangement explains also the superstructure with a three-fold parameter a = 11.90 kX, which was found on all photographs taken around axes a, b and c. A slight double periodicity in the direction of axis c (c = 8.27 kX) was observed on the photographs taken around axis c. A probable explanation of the structure is given and the most probable group is derived. (auth)

6407 A/CONF.15/P/2111

OBMEN IODA MEZHDU DIIODFLUORESTSEINOM I IODISTYM KALIEM. (Isotopic Exchange Reaction Between Diiodofluorescein and Potassium Iodide). J. Říkovská (Czechoslovakia). 11p.

The kinetics of the isotopic exchange of the iodine ion between diiodofluorescein (IFI) and KI was studied. Methanol was used as a solvent. Diiodofluorescein labelled with I^{131} is required for medical purposes to localize brain tumors. One may suppose that two atoms of iodine in the molecule of diiodofluorescein are chemically equivalent, as demonstrated by the results obtained. The exchange rate was evaluated for different concentrations and different temperatures. The exchange probably follows the reaction of the second order, and the activation energy of this exchange was found to be 9650 ± 150 cal/mole. The carbon-iodine bond is strongly polarized, as shown by the relatively short half-time and small activation energy. This method can be used for preparing diiodofluorescein labelled with I^{131}. (auth)

6408 A/CONF.15/P/2125

K MEKHANIZMU TEPMICHESKOI PEREGRUPPIROVKI FTALEVOKISLOGO KALIYA I KARBOKSILIROVANIYA BENZOINOKISLOGO KALIYA. (Mechanism of the Thermal Rearrangement of Potassium Phthalate and the Carboxylation of Potassium Benzoate.) J. Ratuský and F. Šorm (Czechoslovakia). 12p.

The reaction mechanism of the thermal rearrangement of potassium phthalate to potassium terephthalate and the thermal carboxylation of potassium benzoate to potassium terephthalate was studied by tracer techniques. A mechanism was proposed which resulted from the observation that when potassium phthalate is subjected to rearrangement in the presence of one equivalent $C^{14}O_2$, the resulting terephthalic acid contains half the original activity. There is a statistical exchange between one carboxyl group and carbon diox-

ide. A mechanism for the carboxylation is proposed from that fact that from a reaction mixture containing two equivalents of potassium benzoate and one equivalent $C^{14}O_2$ benzoic acid having only one-third of the specific activity and terephthalic acid having two-thirds of the specific activity were isolated. (J.S.R.)

6409 A/CONF.15/P/2136
CARBONATE COMPLEX THORIUM COMPOUNDS. I. I. Cherniayev, V. A. Golovnia, and A. K. Molodkin (Academy of Sciences, U.S.S.R.). 23p.

The conditions are specified for which sodium pentacarbothoriates are formed. A unity of views is established on thorium coördinating number for a complex carbonate anion of this type. This required studying of the character and strength of linked water in hydrated forms of pentacarbothoriates and carrying out chemical and physiochemical research on pentacarbothoriate type compounds. (W.D.M.)

6410 A/CONF.15/P/2137
SPECTRAL ANALYSIS OF IMPURITIES IN ZIRCONIUM AND ITS COMPOUNDS. Y. I. Korovin and L. V. Lipis (U.S.S.R.). 15p.

A study was made of a direct spectral method which allows the simultaneous determination of 24 elements in zirconium and its compounds with high sensitivity and reasonable accuracy. The method is based on the use of a discharge in a hollow cathode. The temperature of the sample, which is in the cathode at constant discharge parameters, is unambiguously related to the discharge current. This makes it possible in principle to reduce considerably the influence of the third components in determining a large group of elements due to a more complete application of the fractional evaporation principle. In the case of many elements it is possible to use absolute blackening due to the great stability of the source of light, while in the other cases the employment of the internal standard considerably improves the calibration curves and the reproducibility of the results. The application of the method suggested saves labor and time in analyzing zirconium and its compounds compared with conventional methods. By using the method, it is possible to determine the impurities in zirconium with high sensitivity, and such determinations, though not optimal, meet the requirements for the quality of zirconium and its compounds. (auth)

6411 A/CONF.15/P/2138
ON THE STRUCTURE OF COMPLEX URANYL COMPOUNDS. I. I. Chernyaev, V. A. Golovnya, et al. (U.S.S.R.). 43p.

A number of complex uranyl compounds containing homogeneous cyclic addends were studied. The existence of three genetic families of complex uranyl compounds was shown. Complex uranyl compounds with heterogeneous cyclic substitutes were synthesized and studied on the basis of the displacing capacity of the addends under investigation. Mixed oxalate complex uranyl compounds containing noncyclic addends were synthesized and studied, such as ureate, acetate, and thiocyanate groups. The investigations conducted showed that uranyl ion, in the compounds studied has the coördination number six. The analyzed addends forming a cycle according to the power of their reciprocal displacing capacity are aligned in series. Carbonate uranyl compounds are the only exceptions from L. A. Chugayev's rule of cycles in the chemistry of complex compounds, exceptions which are caused by the nature of both the formation of complexes and of the addends. (auth)

6412 A/CONF.15/P/2195
ISSLEDOVANIE REAKTSII KHLORIROVANIYA DVUOKISI URANA I DVUOKISI PLUTONIYA CHETYREKHKHLORISTYM UGLERODOM. (Investigations of Uranium Dioxide and Plutonium Dioxide Chlorination with Carbon Tetrachloride.) I. V. Budaev and A. N. Vol'skii (U.S.S.R.). 48p.

The results of investigations of uranium dioxide and plutonium dioxide chlorination with carbon tetrachloride are described. A number of experiments were made using carbon tetrachloride to study the mechanism and rate of uranium dioxide and plutonium dioxide chlorination at various temperatures. The thermodynamic analysis of the most important reactions taking place during uranium dioxide chlorination with carbon tetrachloride is discussed. Standard free energy and equilibrium constant equations were deduced as a function of temperature. The solids and gases obtained in the chlorination process were subjected to thorough qualitative and quantitative analyses. The investigations show that the composition of the resulting gases is considerably changed, depending on the temperature and duration of chlorination. The compositions of the gases and solid compounds point to the mechanism of this process and to its dependence on temperature. The differences in the kinetics of chlorination in carbon tetrachloride flow and in a closed space were established. An account of the study of the plutonium dioxide chlorination with carbon tetrachloride is also given. (auth)

6413 A/CONF.15/P/2208
POLUCHENIE I SVOISTVA NEKOTORYKH DVOINYKH FTORIDOV CHETYREKHVALENTNOGO PLUTONIYA. (Preparation and Properties of Plutonium Fluorides.) I. F. Alenchikova, L. L. Zaitseva, et al. (U.S.S.R.). 20p.

Some results of investigation on methods of preparing complex plutonium fluorides and studying their properties are presented. (auth)

6414 A/CONF.15/P/2231
VYDELENIE INDIVIDUAL'NYKH REDKOZEMEL'NYKH ELEMENTOV. (Separation of Individual Rare Earth Elements.) D. I. Ryabchikov, M. M. Senyavin, and Yu. S. Sklyarenko (U.S.S.R.). 19p.

After opening up the minerals (by acid, alkali, chlorine, etc., depending on their composition), the sum of RE is divided preliminarily into the cerium and yttrium groups on the basis of the double sulfates or carbonates. Separation of the major part of the cerium prevailing in the cerium group is based on its transformation to the tetravalent state and on the fact that it differs from the trivalent elements with respect to complex formation with oxalate and acetic ions; lower basicity; and extractability of ceri-nitric acid complex by diethyl ether. As the yttrium group is separated mainly by chromotographic procedures, the separation of ballast yttrium (65 to 85% of the group sum) is a very difficult problem. A large proportion can be removed simply and quickly by complex formation with trylon B. As samarium, europium, and ytterbium can be transferred to the bivalent state, they are separated electrolytically on a mercury cathode in the presence of potassium citrate which forms complexes with the RE. Elements of the yttrium group and high-purity compounds of the other RE are produced by ion-exchange chromatography, involving the use of various eluants for certain pre-set experimental parameters (concentration, pH, rate, temperature, etc.). Various analytical procedures were developed and are now in use. X-ray spectral methods

are employed for ores and intermediates, spectral and radioactivation-chromatographic methods for checking the purity of the finished products, and a colorimetric method for cerium. Spectral purity was obtained on a semi-commercial scale. (tr-auth)

6415 A/CONF.15/P/2242

QUICK DETERMINATION OF THE PHOSPHORUS CONTENT OF STEEL DURING THE MANUFACTURING PROCESS BY ISOTOPE DILUTION ANALYSIS. Joseph Fodor and Charles Varga (CSEPEL Works, Budapest). 15p.

To determine the phosphorus content of steel and to control the dephosphorizing process, respectively, isotope dilution techniques were used during analysis. Requirements for quick analysis can be satisfied only by using isotope dilution techniques. In the small-furnace (arc furnace of 2 kg capacity) experiments the use of elementary red phosphorus was found the most appropriate. The P^{32} isotope was introduced in a suitable vessel into the steel bath of the open-hearth furnace in the fusion period. Periodically taking samples from the metal bath and cooling them in the mold, the beta radiation of the sample was measured by means of an end-window GM-counter tube. For a saturated layer thickness the counting rate obtained is proportional to the quantity of phosphorus. Once the absolute phosphorus content of the first sample has been determined by means of chemical analysis, the counting rate gives the absolute phosphorus content of the steel. A method was elaborated for introducing the P^{32} isotope into the metal bath, so that it will be distributed within the bath in ~5 minutes. A sampling method was used that allows the phosphorus content to be found within five minutes from the time of the sampling. The accuracy of the proposed method attains that of chemical analysis, and the accuracy can be increased by increasing the counting time or the quantity of isotope introduced. (auth)

6416 A/CONF.15/P/2310

SORBTSIYA MIKROKOLICHESTV STRONTSIYA I TSEZIYA V POCHVAKH. (Sorption of Tracer Amounts of Strontium and Cesium in Soils.) V. M. Klechkovskii (Klechkovsky), G. N. Tselishcheva, and L. N. Sokolova (U.S.S.R.). 19p.

The results of radioisotopic experiments on the processes of adsorption by soils of tracer amounts of strontium and cesium are presented. Data are given on the intensity of adsorption and on the desorption of tracer amounts of strontium and cesium in different soils because the sorptive properties of soils are an important factor which determines the mobility of these elements and their capacity of translocating in the soils and of being assimilated by plants. A comparison is made between the role played by calcium of the soil as a "non-isotopic carrier" of radioactive strontium and the role played by potassium as a "non-isotopic carrier" of radioactive cesium in the sorption process in the soils. On the basis of investigation some figures are cited which characterize specific features of the behavior of tracer amounts of strontium and cesium in different soils. (auth)

6417 A/CONF.15/P/2332

A MODALITY OF THE ISOTOPE DILUTION METHOD OF CHEMICAL ANALYSIS, APPLIED TO THE DETERMINATION OF PHOSPHORUS. J. M. Arriaga e Cunha and J. Baptista (Estação Agrónomica Nacional, Sacavém, Portugal). 9p.

A constant amount of phosphorus is precipitated from two aliquots of an unknown labeled phosphate solutions to one of which a known weight of inactive phosphorus is added. From the activities remaining in the supernatant solutions, and from the weight of phosphorus in the precipitate, the phosphorus content of the solution is calculated. The results obtained with the proposed method in the estimation of phosphorus in a solution with a known concentration of this element agreed closely with those obtained in the same solution by the colorimetric method of Allen. It is emphasized the need for checking the accuracy of the method in cases where the determination of phosphorus by conventional methods is difficult. (auth)

6418 A/CONF.15/P/2340

THE INFLUENCE OF DEUTERATION ON THE PROPERTIES OF SOME BIOLOGICALLY ACTIVE ORGANIC MOLECULES. N. P. Buu-Hoi and N. D. Xuong (Republic of Vietnam). 7p.

Deuterium has hitherto been tilized mostly for the labeling of molecules, but the intrinsic properties of deuterated compounds have only rarely been investigated. In the framework of a vast program of investigation of deuterated and tritiated organic compounds of known structure, a large number of substances containing a high proportion of deuterium in place of hydrogen have now been synthesized, and their biological properties assessed comparatively with those of their hydrogen analogs. Thus, convenient methods of synthesis have been devised for the preparation of diverse types of molecules, including straight chain and ramified fatty acids (some examples being the hexadeuteriovaleric acid of formula $CHD_2-(CHD)_3-CD_2-CO_2H$, the octadeuterioheptoic acid of formula $CHD_2-(CHD)_2-CD_2-(CHD)_2-CO_2H$, and the tetradecadeuterated tuberculostearic acid of formula $CH_3-CHD_2-(CHD)_2-CD_2-(CHD)_2-CH_2-CH(CH_3)-CH_2-CD_2-(CHD)_2-CD_2-(CH_2)_3-CO_2H$ and their esters, alcohols, hypnotics, estrogens (e.g., a penta- and a decadeuterated derivative of a-bromotriphenylethylene), carcinogens, mitoclastic compounds and plant hormones, etc., all of them entirely or largely deuterated in well-defined positions. In many instances the biological properties displayed by the deuterated molecule were noticeably different, not only quantitatively but also qualitatively, from those of the nondeuterated compound. Some of the manifold prospects for the practical applications of these findings in medicine and in industry are discussed. (auth)

6419 A/CONF.15/P/2444

THE USE OF SURFACE LABELLING WITH RADIOACTIVE GASES IN THE STUDY OF PASSIVE FILMS ON METALS. Č. Jech (Czechoslovakia). 12p.

Steel and zinc surfaces were exposed to the action of an electric discharge in a gaseous discharge containing radioactive inert gas. During the discharge atoms of the radioactive gas are ionized, electrostatically accelerated, and deposited beneath the surface where they are retained in a layer ~1 mg/cm^2. This technique was used in the study of the corrosion inhibition of chromic ion films on steel and zinc. (W.D.M.)

6420 A/CONF.15/P/2490

PHASE EQUILIBRIUM DIAGRAMS OF SYSTEMS UO_2-ZrO_2 AND ThO_2-ZrO_2. N. M. Voronov, E. A. Voitekhova, and A. S. Danilin (U.S.S.R.). 17p.

Phase equilibrium diagrams of the systems UO_2-ZrO_2 and ThO_2-ZrO_2 were plotted. The diagram of the UO_2-ZrO_2 system differs from the one published previously only by a decrease of the single-phase region at low temperatures, while the diagram of the ThO_2-ZrO_2

system hardly corresponds to the findings published about it by previous investigators. It follows from the diagrams of UO_2-ZrO_2 and ThO_2-ZrO_2 that the tendency of the components in both systems to form eutectic mixture which is preconditioned by a substantial difference in the cation sizes is not realized, and the transition from the liquid state to a solid one terminates by the formation of solid solutions: continuous in the case of UO_2-ZrO_2 and containing from 0 to 87 mole % of ZrO_2 in the case of the ThO_2-ZrO_2 system. However, the difference in the sizes of the cations entails in both systems a discontinuity of solubility in a solid state. Because of difference in the sizes of the ions of zirconium and thorium, which is bigger than the difference between the ions of zirconium and uranium, the disintegration of the ThO_2-ZrO_2 solid solution begins at a higher temperature than the disintegration of the solid solution of UO_2-ZrO_2. The greater difference in the sizes of Zr^{4+} and Th^{4+} than between Zr^{4+} and U^{4+} explains also the fact that in the case of the UO_2-ZrO_2 system the transition from a cubic UO_2 solid solution to a tetragonal ZrO_2 one is continuous while the same transition (of a ThO_2 solid solution) in the ThO_2-ZrO_2 system takes place through an intermediate, although a narrow two-phase region. The stability of the tetragonal solid solution in the UO_2-ZrO_2 system to lower temperatures than of the ThO_2-ZrO_2 system may be also explained by the difference in the cation sizes. (auth)

6421 A/CONF.15/P/2491
BRAZILIAN PRACTICE OF RARE EARTHS SEPARATION. P. Krumholz, K. Bril, S. Bril, J. Behmoiras, F. Gottdenker, and F. W. Lima (Research Lab. of Orquima S.A., São Paulo, Brazil). 40p.

Experiences in the field of rare earth separation gained from ten years of laboratory work are reported. Most of the methods described were tested on a pilot plant scale and many in full scale industrial units. The general principles underlying the methods of rare earth separation are discussed and illustrated with practical examples. A general separational scheme for all rare earth elements is considered that is applicable on large scale industrial production. (W.D.M.)

Radiation and Radiochemistry

6422 A/CONF.15/P/47
ACTION OF IONISING RADIATIONS ON AQUEOUS SOLUTIONS OF CARBOHYDRATES. G. O. Phillips, G. L. Mattok, and G. J. Moody (University Coll., Cardiff, Wales, Eng.). 19p.

The degradation of carbohydrates in aqueous solution by ionizing radiations has been examined by several methods. Paper chromatographic and isotope dilution methods were used to identify and estimate the products. A consistent pattern was evident in the behavior of monosaccharides, polysaccharides, and sugar alcohols. D-glucose was degraded in aqueous solution by cobalt-60 gamma radiation and 1 Mv electrons. The acid yield indicated that the extent and type of degradation was similar in both cases. Variation in glucose concentration and dose rate within the limits employed did not influence the acid yield in vacuum or in oxygen. The following constituents were estimated in the solution irradiated under oxygenated conditions: unchanged glucose, D-glucuronic acid, D-gluconic acid, glyoxal, D-arabinose, D-erythrose, formaldehyde, saccharic acid, and 1,3-dihydroxyacetone. The products correspond to more than 90% of the glucose consumed. Primary and secondary products were distinguished by measuring the rate of formation of the main products with dose. The results indicate three distinct types of scission of the glucose molecule. The irradiation of D-mannose solutions was examined in a similar manner. The main products formed during the irradiation of dextran solutions with cobalt-60 gamma radiation were D-glucose, iso-maltose, iso-maltotriose, D-gluconic acid, D-glucuronic acid, glyoxal, D-erythrose, and D-glyceraldehyde. Aqueous solutions of D-sorbitol on irradiation in oxygen gave D-glucose, L-gulose, D-arabinose and L-xylose, and also secondary products formed from these compounds. The yield/dose curves for the main products indicate that the hexoses are the primary products. All the irradiated carbohydrate solutions showed a characteristic absorption at 265 mμ. Evidence is presented that this is due to the presence of 1,3-dihydroxyacetone formed by isomerization of D-glyceraldehyde. (auth)

6423 A/CONF.15/P/51
THE EFFECT OF FAST ELECTRONS AND FAST NEUTRONS ON POLYPHENYLS AT HIGH TEMPERATURES. W. G. Burns, W. Wild, and T. F. Williams (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 24p.

Biphenyl, ortho-, meta-, and para-terphenyls, and a commercial mixture of these (Santowax-R) have been subjected to fast electron beams and to irradiation in BEPO at temperatures between 250 and 400°C. Gas production and polymer formation were measured, and in some cases the changes in a variety of physical properties were studied. No great differences of stability were observed among these compounds. The initial yields of gas and polymer increased with rise in temperature, the effect on gas production being more pronounced. On continued irradiation the instantaneous rate of polymer formation decreased. Striking decreases were produced by the deliberate addition of polymer, suggesting that the latter contained a protective agent. The two types of radiation did not produce equivalent effects. Differences in relative amounts of products were observed. The initial radiation yields of all products were markedly greater using pile radiation. These yields increased more rapidly with rise in temperature than did those obtained with electron irradiation. The concept that equal energy inputs from differing types of radiation cause equal damage does not seem to hold for this class of compound. (auth)

6424 A/CONF.15/P/63
THE EFFECT OF IONISING RADIATION ON SOLID CATALYSTS. E. J. Gibson, R. W. Clarke, T. A. Dorling, and D. Pope (Gt. Brit. Dept. of Scientific and Industrial Research). 14p.

Some results obtained during a study of the irradiation of iron oxide catalysts with the gamma radiation from Cobalt-60 are presented. The main interest has been in the use of these catalysts for reactions involving carbon monoxide and hydrogen. It was found that after a dose of gamma radiation of the order of 1 to 5×10^7 rep, some iron oxide catalysts show a long-lived increase in activity for the synthesis of hydrocarbons from carbon monoxide and hydrogen at 280°C and 10 to 20 atm. pressure. The increased activity persists to the end of the tests, some of which lasted 300 hours. The product obtained using the irradiated catalyst did not differ significantly from that obtained using the untreated catalyst. Not all iron oxide catalysts for this

reaction can be affected in this way, and some differences between the catalysts are discussed. Measurements of electrical conductivity, oxo-electron emission, and other properties were made on some of the catalysts tested, and the information so far obtained is discussed in relation to the catalytic activity of the samples. (auth)

6425 A/CONF.15/P/65

SOME RECENT ADVANCES IN THE CHEMICAL UTILIZATION OF FISSION PRODUCTS. R. Roberts, F. L. Dalton, P. Hayden, and P. R. Hills (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 19p.

The development of nuclear power programs has led to a study of reactions initiated by radiation which might be of industrial importance. Some of the work which has been carried out on polymerization and halogenation is described. The program of work in polymerization concerns the radiation-initiated polymerization of fluorocarbon olefins and a study of graft copolymerization. Halogenation studies are represented by work on the chlorination of benzene. (W.D.M.)

6426 A/CONF.15/P/69

CLINICAL APPLICATIONS OF ACTIVATION ANALYSIS. J. M. A. Lenihan (Western Regional Hospital Board, Glasgow) and Hamilton Smith (Glasgow Univ.). 10p.

Applications of activation analysis in hospital practice, clinical science, and forensic pathology are discussed. Procedures are described for the determination of arsenic following activation of samples in a nuclear reactor. The procedure was applied in measurements of arsenic levels in normal hair from a group of 100 subjects. A correlation was made with smoking habits, since cigarettes were found to contain an appreciable amount of arsenic presumably from insecticides used on the plants. Results were negative. Measurements revealed elevated arsenic content of hair, finger nails, skin, and beard hair from a patient with suspected arsenical poisoning. Inquiry revealed that for the past 12 years he had consumed daily doses of a mixture containing arsenic and potassium bromide. A worker in a sheep dip factory was also found to have elevated arsenic levels in skin, nails, hair, and beard. Levels of arsenic in beard hair dropped from 3.12 ppm to 0.94 ppm during a month's hospital stay. An account is included of a police investigation of suspected criminal arsenical poisoning being dropped following activation analysis of samples of vomitus. The methods used for arsenic are also applicable to determinations of antimony, copper, manganese, phosphorus, mercury, and zinc. (C.H.)

6427 A/CONF.15/P/76

THE POSSIBILITY OF THE DIRECT APPLICATION OF FISSION RECOIL FRAGMENT ENERGY TO INDUSTRIAL CHEMICAL PROCESSES. J. K. Dawson, G. Long, F. Moseley, and R. G. Sowden (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 21p.

The relationships between the reactor parameters, such as operating temperature and pressure and fuel enrichment, and the chemical parameters are assessed, based on a reactor designed specifically for chemical production. An estimate is made of the cost and production rate of large-tonnage chemicals by large gas-cooled reactors 20 to 25 years hence. The experimental data on chemical yields from fission fragment bombardment are limited; however, it is believed that a desirable first step would be the production of small quantities of synthetic chemicals in individual channels fitted into existing reactor designs. (J.R.D.)

6428 A/CONF.15/P/140

A RAPID METHOD FOR THE DETERMINATION OF COBALT IN REACTOR STEEL BY ACTIVATION ANALYSIS. Torbjörn Westermark and Ingrid Fineman (Royal Inst. of Tech., Stockholm). 12p.

The method is based on the use of the metastable isomer $Co^{60\,m}$ which precedes the long-lived Co^{60} after neutron capture. $Co^{60\,m}$ emits 59-kev gamma radiation and has only 10.8 minutes half life. This enables the use of a very short activation time, about 10 minutes in the Stockholm reactor R1 at 5×10^{11} n/cm^2 sec. The method has been applied to various Swedish steels. Here the presence of manganese is the most disturbing factor which has so far prevented the use of the direct spectrometric analytical technique (thick NaI crystal scintillation detectors and a single-channel pulse-height analyzer). A fast chemical procedure (especially developed by Ingrid Fineman) has been used to avoid this difficulty. It involves rapid dissolving of steel turnings in hydrochloric acid, extraction of iron into diethylether, and selective precipitation (after addition of carrier) of cobalt with nitroso-naphthol. The procedure also makes self-absorption of the soft gamma radiation negligible. A small activity of long-lived Co^{60} is added to the dissolving acid. This is chosen so as not to disturb the spectrometry but to enable corrections for losses of cobalt during the procedure. The standard consists of a small filter paper on which a small volume of cobalt solution is evaporated. The whole procedure after activation takes 30 to 40 minutes and seems to be capable of achieving a sensitivity limit of 1 to 2 μg at the neutron flux used. The estimated maximum error is 5 to 10% in the region 50 to 150 ppm if the sample is 0.1 gram and the above-mentioned flux is used. (auth)

6429 A/CONF.15/P/176

ON THE USE OF TRITIUM AS A TRACER FOR WATER IN NATURE. B. Bolin (International Meteorological Inst., Stockholm). 19p.

A detailed discussion of the natural and artificial tritium in nature is given based on measurements conducted by W. F. Libby and his co-workers in Chicago. A discussion of the global distribution of tritium requires a more detailed knowledge of certain microphysical processes. It is of particular interest to study the exchange of tritium between falling rain drops and the environmental air and the average vertical distribution of tritium due to atmospheric turbulence. It is shown that drops of 0.1 mm radius on an average have a tritium content representative of the last 5 to 10 m air they have passed through. For drops with 0.5 and 1.0 mm radii the corresponding figures are 400 m and 1600 m. No similar adjustment of the tritium content of snow can occur and a systematic difference between rain and snow should exist which is verified by the Chicago data. The average vertical flux downward of tritium in the atmosphere is partly due to precipitation, partly due to turbulence, and a direct molecular exchange at the ocean surface. The associated vertical gradient necessary for maintaining a turbulent transport is used to establish an upper limit for the total flux of tritium. This permits an estimate of the total amount of tritium stored in the ocean, which is particularly interesting

for considerations about the vertical turn-over of the ocean. The bomb tritium released in March 1954 in the Pacific caused a marked increase of the tritium concentration in rain, rivers, and lakes over the United States. It is shown how a relatively rapid exchange between the atmosphere and upper parts of the soil takes place, resulting in the evaporation of large amounts of the tritium deposited by precipitation. Furthermore, the direct molecular exchange of tritium between the atmosphere and lakes plays an important role and has previously led to an overestimate of the amount of bomb tritium deposited on the American continent. Much less tritium is therefore brought into the ground water reservoir. The study of the variations of tritium in precipitation and particularly the decrease observed during the summer of 1954, after the bomb tests, is used for an estimate of the amount of moisture in the soil being in exchange with the atmosphere through evapotranspiration. The fact that this decrease stopped in the fall 1954, at a level well above the one observed before the bomb tests began, indicates a continuous supply of tritium from the stratosphere, which is larger than the natural production, since the relatively high tritium amounts present in the ground water are effectively sealed off from exchange with the atmosphere and therefore cannot possibly effect conditions in the atmosphere. Finally, a number of arguments are presented showing that the natural production of tritium in the troposphere plus the flux from aloft is approximately 1 atom cm^2 sec^{-1}. (auth)

6430 A/CONF.15/P/189
ACTIVATION ANALYSES OF INTEREST TO ATOMIC ENERGY PROGRAMS. R. E. Jervis and W. D. Mackintosh (Atomic Energy of Canada Ltd., Chalk River, Ont.). 18p. (AECL-599). $0.25(AECL).

Some applications of the neutron-activation technique to various analytical problems that have arisen in the reactor research and nuclear power development programs at Chalk River are described. Methods are described for investigating impurities, corrosion pits, and surface defects of aluminum and Zircaloy-2 and for determining the uranium content of reactor materials. (W.D.M.)

6431 A/CONF.15/P/271
SYNTHETIC INORGANIC ION EXCHANGERS AND THEIR APPLICATIONS IN ATOMIC ENERGY. C. B. Amphlett (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 12p.

Highly stable, granular, selective ion exchangers are being studied with a view to their application to the treatment of high-temperature pressurized water, chemical separations in intense radiation fields, and for normal separations where increased specificity is desirable. These materials include zirconium phosphate, arsenate, tungstate, molybdate, and oxide; oxides and phosphates of thorium and titanium, and tungsten oxide. The salts possess cation-exchange properties; tungsten oxide is a cation-exchanger, while the other oxides are amphoteric and may be used for either cation or anion exchange depending on the conditions. In the case of zirconium phosphate, the effect of variation in manufacturing method on the properties of the product has been studied on the 1 kg scale using standard pilot-scale equipment, and several large batches have been prepared for comparative testing, over a range of mesh sizes suitable for large-scale column operation. (auth)

6432 A/CONF.15/P/284
RADIATION LABELLING OF ORGANIC COMPOUNDS WITH C^{14}. C. N. Turton (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 9p.

Radiation-induced reactions between organic compounds and simple carbon-containing gases (CO_2 and C_2H_2) labelled with C^{14} were examined. The reactions were carried out in the gas phase with Kr^{85} added to the systems as a source of β radiation. Reaction products containing C^{14} were isolated, and their nature and position of labelling with the active isotope were investigated. (auth)

6433 A/CONF.15/P/286
THE USE OF RADIOACTIVE ISOTOPES IN THE STUDY OF REACTION MECHANISMS. J. C. Bevington and D. E. Eaves (The University, Birmingham, Eng.), J. Toole (I.C.I., Ltd., Manchester, Eng.), and L. Trossarelli (The University, Turin). 7p.

The mechanisms of certain free radical reactions, in particular those of importance in the polymerizations of monomers such as styrene are considered. Certain substances, when present at low concentrations, affect profoundly the course of these polymerizations; both the rate of polymerization and the average molecular weight of the resulting polymer may be altered. In many cases, traces of the additives become incorporated in the polymer forming the end-groups of macromolecules. In other cases, the substances are converted to other materials of low molecular weight. In the past, the actions of the additives have been studied by rather indirect methods but tracer techniques permit direct approach to the problems. In the first of the examples discussed here, the action of certain substances which act as initiators for polymerizations have been investigated. Aroyl peroxides dissociate to radicals according to the general equation: $R.CO.O.O.CO.R \rightarrow 2\ R.CO.O.$ The resulting radicals may dissociate thus: $R.CO.O \rightarrow R + CO_2$. Both the radicals R.CO.O and R can initiate polymerizations forming the end-groups of the polymer molecules. A description is given of experiments in which the nature of the group R was varied. It is shown that the stability of the radical R.CO.O is very sensitive to small changes in the chemical nature of the group R. In most cases the group R has been labelled with carbon−14. It has been shown however, that if the group contains certain elements, e.g., bromine, it is possible to use the method of neutron activation analysis for determination of the end-groups of polymer molecules. In the second example, a report is given of a new type of study of a transfer reaction. The work has involved the use of triphenylmethane labelled with both carbon−14 and tritium. A growing polymer radical may abstract a hydrogen atom from the substituted methane, and the resulting triphenylmethyl radical may re-initiate the growth of a polymer chain by attacking a molecule of monomeric styrene. By labelling the molecule suitably, it is possible to compare the rates of the two steps in the whole transfer process and to make a detailed study. It has been found that there is evidence for quite a large isotope effect in the abstraction of hydrogen atoms from molecules such as triphenylmethane. The studies reported here are of importance in polymer chemistry but also in the wider field of general radical chemistry. (auth)

6434 A/CONF.15/P/288
COBALT 60 PRODUCTION IN THE U.K. ATOMIC

ENERGY AUTHORITY. W. S. Eastwood, R. West, and E. R. Wiblin (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 20p.

All the aspects of production and handling of Co^{60} to meet the demands for therapy and industrial radiation are considered. Source sizes, cobalt specification, oxide formation, capsuling, and gas flushing of cans are discussed. The use of pile fluxes to best advantage, flux depressions and heat generation in the samples are set out with illustrations of the current practice at Harwell. The measurement of radiation output by ion chambers is described and its relation to the disintegration rate. Handling and storage of many thousands of curies is discussed. Some storage arrangements in use are shown. Various loading problems are outlined for therapy and industrial machines using a concrete loading cell and also small lead-wall cells using ball-joint manipulator tools. The design of source patterns for specific irradiations is shown and considerations regarding safety and transport of sources are given. (auth)

6435 A/CONF.15/P/326

FIXATION DU BROME ET DE L'HEXAFLUORURE D'URANIUM SUR LES CARBONES. (Fixation of Bromine and of Uranium Hexafluoride on Carbon). J. Maire (Societe "Le Carbone-Lorraine," France). 14p.

The fixation of bromine on pitch coke, paraffin coke, petroleum, coke, and various blacks was studied. The sorption curves were determined as a function of the bromine partial pressure. The results obtained with petroleum coke and pitch coke are analogous to those obtained with graphite. The paraffin cokes and blacks give isotherms sharply different from those of other carbons. In the study of fixation of uranium hexafluoride on carbon, it was found that the hexafluoride is adsorbed by graphites and graphitized carbons and gives a lamellar compound. The stability of this compound was determined. Uranium hexafluoride can be removed from a nitrogen stream by passage over graphite, and the hexafluoride is purified of traces of HF. (J.S.R.)

6436 A/CONF.15/P/467

CONCENTRATION OF CARRIER-FREE RADIOISOTOPES BY ADSORPTION OF ALUMINA. S. R. Veljković and S. M. Milenković (Inst. of Nuclear Sciences "Boris Kidric," Belgrade). 14p.

Carrier-free radiosulfur in the form of bisulfate is easily separated from chlorides by adsorption on alumina. The separation was efficient from 4 M alkali chlorides or 5 M HCl or 2 M solutions of III analytical group metal chlorides or others. Recovery of the adsorbed S^{35} by a small volume of ammonia is in the range of 90%. The P^{32} in its form of phosphate is separated by magnesium carriers, and the solution is finally passed through a cation exchanger resin column and evaporated to the desired volume. The conditions of the adsorption and elution of carrier-free S^{35} in mixtures with the above salts are given. The effects of the concentrations and the nature of the ions present, as well as the temperature and the flow velocity, are shown. The nature of the separation process is determined and the corresponding constants calculated. Similar favorable conditions can be used for P^{32} separation from irradiated sulfur. Sulfur is dissolved in CS_2 or other organic solvent, and the phosphate present is separated by adsorption on alumina. Similar procedures may be applied to the separation of chromates. The process eliminates the necessity of using great bulks of the solutions (as usually used in most separations of S^{35}). It is efficient at very high concentrations of chlorides and allows a fast preparation of pure specimens. (auth)

6437 A/CONF.15/P/549

A SIMPLE PROCEDURE FOR THE DETERMINATION OF ^{89}Sr AND ^{90}Sr IN URINE AND SEA WATER. J. Koo (Reactor Centrum Nederland, The Hague). 7p.

Recently a method for the determination of radioactive strontium in water samples was developed. Concentration is achieved by direct precipitation, and the total strontium content is obtained in about 5 hours, Sr^{90} in about 24 hours. The method does not require any special reagents or apparatus and is very well suited for routine application. Finally, it is very selective and sensitive to less than one tenth of the M.P.C. for Sr^{90}. Radiobarium may be determined almost without any additional effort. As some of the advantages mentioned are of still more importance in the routine analysis of samples of urine and seawater, the method has been examined for use in these cases. Experimental data are presented to prove its applicability. The necessary changes in the procedure are given. (auth)

6438 A/CONF.15/P/962

RADIATION CHEMICAL REACTIONS IN ORGANIC SYSTEMS: REACTIONS ON MACROMOLECULAR SUBSTANCES AND THE SULFINATION OF HYDROCARBONS. A. Henglein, K. Heine, et al. (Univ. of Cologne). 29p.

Graft polymers by γ radiation. Upon irradiation of a polymer in the presence of a vinyl compound by γ rays free, macro-radicals resulting from the decomposition of the polymer initiate the polymerization of the monomer. Systems investigated comprised 3 components. A definite form of a polymer dips into an "inert" fluid having no swelling or dissolving capacity for the polymer. The monomer vinyl compound is dissolved in the fluid in an adequate concentration. Before irradiation the vinyl compound slowly diffuses into the polymer. Because the γ rays affect the whole system, those parts of the polymer are grafted which contain the infiltrated monomer. Furthermore, homo-polymerization of the monomer in the solution takes place. Depending on the diffusion before irradiation, there results a grafting of the surface layer of the polymer (surface grafting) or a grafting extending to the interior of the polymer (bulk or total grafting). Oxygen cancels the homo-polymerization in the solution. Oxygen diffuses from the solution into the polymer and inhibits polymerization in a thin layer just under the surface. In this case, grafting is effected in a layer in the interior of the polymer (imbedded grafting). The kinetics of these different graft processes was studied for several systems and the properties of the resulting products were investigated. Degradation and cross-linking of macromolecules in solution: For the degradation by γ rays of the main chain of polymethylmethacrylate, different mechanisms are operative: direct and indirect radiation effects and energy transfer between excited states of the polymer and of the solvent. The prevailing mechanism depends on the solvent. The degradation may be essentially decreased either by defined mixtures of solvents or by the addition of certain compounds in very small concentration. Polystyrene in solution undergoes at the same time a degradation of the main chain and an intermolecular cross-linking. With increasing concentration of the polymer, the cross-linking increases at a higher rate than the degradation. Cross-linking depends on the

solvent, i.e., "bad" solvents give an improved cross-linking and vice versa. Even small amounts of substances known as inhibitors for radical chain polymerizations suppress cross-linking of polystyrene. Sulfination of organic compounds: Organic substances undergo reactions with sulfur dioxide under the influence of γ rays and high-energy electrons. Hydrocarbons, for instance, form sulfonic and sulfinic acids, sulfones, and sulfoxides. G-values for several substances undergoing reaction with sulfur dioxide were determined and also the quantities of the resulting compounds. (auth)

6439 A/CONF.15/P/963
FORMATION OF RADICALS BY ULTRAVIOLET AND IONIZING RADIATIONS AND THEIR REACTIONS IN PLASTICS. Günther O. Schenck, Werner Meder, and Martin Pape (Univ. of Göttingen, Ger.). 30p.

Irradiation was performed on plastic films in which several component systems to be studied were dissolved. The plastics were irradiated with electrons (150 kev to 15 Mev), x rays, and γ rays, as well as with quartz-mercury ultraviolet rays. The observation of the radical formation was usually made spectrokinetically using a Beckman recording spectrophotometer DK-2. (W.L.H.)

6440 A/CONF.15/P/970
CHEMICAL DOSIMETRY OF X-RAYS, γ-RADIATION, AND FAST ELECTRONS BY THE FERROUS SULFATE METHOD. Segurd Rösinger (Technical Univ., Stuttgart). 12p.

The chemical dosimetry of x, gamma, and beta radiations was studied using a ferrous sulfate solution. An attempt was made to determine the electron energies or ionization densities at which the G value of the ferrous sulfate reaction starts to decrease. An investigation was made of whether this method yields an adequate description of the biological effectiveness of different types of radiations. The degree of energy absorption was measured by the oxidation of the solution, the ferric ion being detected photometrically. The sources of error which lead to the different values quoted in the literature for dosimetry with ferrous sulfate solutions are discussed in detail. The method does not yield an adequate description of the biological effectiveness of various radiations. (J.S.R.)

6441 A/CONF.15/P/983
CONTINUOUS MEASURING OF HYDROGEN IN HYDROCARBONS BY BETA-RAY ABSORPTION. R. Berthold (Wildbad/Schwarzwald, Ger.). 7p.

With beta counters fitted on the outside of a pipeline, continuous density measurements can be carried out with an accuracy of ± 0.2% provided that suitable measuring heads will be used. When high weight per cents of hydrogen are present, the ratio Z/A for this compound will be twice as large as for the neighboring light elements, resulting in an anomalous scattering of the beta radiation in relation to the hydrogen content. This anomaly was used to determine the H/C ratio in aromatic hydrocarbons. As a result of the H/C ratio in hydrocarbons they can now be controlled continuously. (W.L.H.)

6442 A/CONF.15/P/985
EXAMPLES FOR THE APPLICATION OF FISSION PRODUCTS AS TRACERS IN THE FIELD OF CHEMISTRY. Hans Götte (Farbwerke Hoechst AG., Frankfurt am Main). 12p.

Some short-lived radionuclides which are useful radio tracers can be produced only by fission. Especially useful are those whose long-lived mother substances can be isolated so that the short-lived radionuclides may be prepared repeatedly for use in any distance of the isotope production center. For long-lived fission products applications have to be found as they form the waste. They should therefore be used, if possible, instead of radionuclides formed by (n,γ) processes. As fission products can be produced carrier-free, preparations of high specific activity are attainable. Examples are given for the application of both kinds of fission products, and an investigation with a mixture of fission products is also mentioned. (auth)

6443 A/CONF.15/P/1052
THE DENATURATION OF PROTEIN BY RADIATION. Engelhardt (Germany). 17p.

The ultraviolet and x-ray denaturation of serum proteins in water was analyzed by measuring the turbidity and determining the number of sulfhydryl groups present. Reaction mechanisms are discussed. Data are included on the effects of oxygen content and the addition of cysteine before and after exposure. (C.H.)

6444 A/CONF.15/P/1094
THE CHEMICAL FATE OF A RADIOACTIVE ATOM. D. L. Baulch and J. F. Duncan (Univ. of Melbourne). 22p.

The chemical reactions which an atom may undergo after decay are determined by the degree of atomic and molecular excitation caused by the decay, the recoil energy of the atom, and the kinetic and thermodynamic properties of the resulting ion or free radical. The role of excitation phenomena and the conditions under which its effects might be minimized are considered in detail. From this, the best conditions for using the recoil process for various purposes are evaluated. Evidence from ionization by gamma radiation, charge production in radioactive decay, internal conversion radiative neutron capture, and decay is considered to determine when conditions can be controlled so that electronic excitation is lost before the bond between the radioactive atom and its parent molecule is affected. The results of this study are applied to the production of high specific activity sources by nuclear reactions and to measurements of chemical binding energies. (J.S.R.)

6445 A/CONF.15/P/1119
THE CARRIER-FREE SEPARATION OF UZ FROM 100 Kg URANYL NITRATE. J. van R. Smit, M. Peisach, and F. W. E. Strelow (South African Council for Scientific and Industrial Research, Pretoria). 11p.

The carrier-free separation of the UX complex from 100 kg $UO_2(NO_3)_2$ and the subsequent milking off of the 6.7-hour UZ activity in a re-investigation of the decay scheme of the UX complex are described. (W.L.H.)

6446 A/CONF.15/P/1156
ACTION DES RAYONS γ ET α SUR LES SOLUTIONS DE PLUTONIUM. (Effect of α and γ-Rays on Plutonium Solutions). M. Pagès and M. Haissinsky (Univ. of Paris). 8p.

The radiochemical reduction of PuO_2SO_4 was studied in sulfuric acid solution. After irradiation with Co^{60} γ-rays, the product first observed is Pu^{4+}. Small amounts of Pu^{3+} appear after prolonged irradiation. The yield for reduction to Pu^{4+} in 0.5N H_2SO_4 solution varies in the usual way with the initial concentration of Pu^{4+}: first increasing with concentration, then becoming independent. The plateau is reached at about 2×10^{-3}M and the yield is then G = 1.7. For an initial concentration of

Pu^{6+} equal to 3×10^{-3}M, G(Pu^{4+}) falls from 2 to 1 as the acid concentration increases from 0.1 to 2N. If the concentration of SO^{2-} ions is fixed, G moves in the opposite direction, increasing from 0.5 to 4.1 as H^+ increases from 0.2 to 0.8N, then appearing to rise more rapidly for greater acidities. At constant acidity, on the other hand, the yield falls from 2.0 to zero as the SO_4^{2-} concentration is increased from 0.1 to 0.9M. The effect of SO_4^{2-} is therefore greater than that of H^+ ions. Self-reduction by plutonium α rays varies with sulfate and hydrogen ion concentrations in much the same way as has just been described for Co^{60} γ rays with similar G values, in both cases, for the same dissipation of energy. For PuO_2^{2+} concentrations between 5×10^{-5} and 9×10^{-3}M, however, the self-reduction yield does not vary with concentration. (auth)

6447 A/CONF.15/P/1172

THE PROCESSING OF IRRADIATED URANIUM; RESULTS OF THE OPERATION OF THE FONTENAY-aux-ROSES PILOT PLANT. P. Regnaut, P. Faugeras, A. Brut, R. Helou, and A. Redon (Commissariat à l'Énergie Atomique, Paris). 75p.

The pilot plant at Fontenay-aux-Roses for the processing of irradiated uranium was put in operation in 1954. The results of four years' experience in the operation of this plant are described in detail. The method used is based on the preferential extraction of the nitrates of heavy metals by tributyl phosphate diluted in a paraffin hydrocarbon. The steps of the process include removal of the cladding, dissolution of the uranium bars, extractions, concentration of the fission product solution prior to storage, concentration of the plutonium solutions, second cycle of plutonium purification, and preparation of plutonium fluoride. The conclusions drawn from this operating experience are discussed. Laboratory investigations on the chemical removal of the cladding, dissolution of the uranium, equipment for solvent extraction, concentration of plutonium solutions, and recovery of metal from slag are also reported. (J.S.R.)

6448 A/CONF.15/P/1179

A PILOT UNIT FOR THE SEPARATION OF CESIUM 137. A. Raggenbass, M. Quesney, J. Fradin, and J. Dufrene (Commissariat à l'Énergie Atomique, Paris). 26p.

A facility is described for the separation of cesium-137 from solutions of fission products and the preparation of three sizes of pellets for use in gamma sources. The necessary manipulations have been simplified as much as possible. The chemical method used for the processing of the fission product solutions is described. Schematic sketches and photographs of the equipment and facilities are included. (C.H.)

6449 A/CONF.15/P/1214

LE COMPORTEMENT DE QUELQUES GAZ POLYATOMIQUES DANS LES REACTEURS NUCLEAIRES. (The Behaviour of Several Gases Under the Influence of Pile Radiation.) L. Dollé (Commissariat à l'Énergie Atomique, Paris). 26p.

The chemical effect of ionizing radiation on polyatomic gases is described. Pile radiation decomposes ammonia into stoichiometric proportions of nitrogen and hydrogen. Colorimetric attempts to detect hydrazine gave negative results. Comparison of results obtained from cobalt-60 γ irradiations with those from pile irradiations show that the reaction $N^{14}(n,p)C^{14}$ is the principal source of energy absorption in the latter case. The recombination of H_2 and N_2 was also observed. The mechanism of NH_3 decomposition is complex, the apparent order of the reaction increasing with the extent of decomposition. H_2S is more rapidly decomposed than NH_3 and the only gaseous product is hydrogen. The sulfur, which is deposited on the walls of the ampules, is clearly visible. Decompositions to the extent of 84% were obtained. The influence of the $S^{32}(n,p)P^{32}$ reaction is considered. The radiochemical decomposition of N_2O gives large yields of products, but the reaction is complicated from the start by the formation of higher oxides of nitrogen which were identified and measured. Methane is decomposed to give large quantities of hydrogen and small amounts of higher hydrocarbons. Ethane gives, in addition, some polymerization products, and ethylene is rapidly polymerized by pile radiation. In this case much more hydrogen is formed than in irradiation with pure γ rays. Some of these gaseous systems lend themselves to the measurement of high doses of radiation. This problem is discussed. (tr-auth)

6450 A/CONF.15/P/1215

PEROXYDATION DE COMPOSES ORGANIQUES INDUITE PAR LES RAYONNEMENTS IONISANTS. (Radiation Induced Peroxidation of Organic Compounds.) M. Durup, J. Durup, F. Kieffer, and M. Magat (Univ. of Paris). 27p.

The oxidation and peroxidation of organic compounds by gamma radiation were studied under three aspects: formation of peroxides, radiochemical degradation of high polymers in aerated solutions, and transformations by anti-oxidants of the β-naphthol type. The mechanism and kinetics for the peroxidation of cumene (isopropyl benzene) were determined. The degradation of polystyrolene in aerated solutions of CCl_4 or $CHCl_3$ by the action of gamma rays was followed. A hypothesis on the formation mechanism and the nature of the different peroxides of polystyrolene was presented. The transformation which β-naphthol undergoes during its irradiation in aerated solutions of hexane was investigated. The results of the study showed that it is possible to describe the majority of the reactions as classical radical reactions. (J.S.R.)

6451 A/CONF.15/P/1220

NOUVELLE METHODE DE PREPARATION DU RADIOPHOSPHATE DE CHROME COLLOIDAL A HAUTE ACTIVITE SPECIFIQUE POUR USAGE THERAPEUTIQUE. ESSAIS BIOLOGIQUES DE LA SUSPENSION. (A New Method of Preparing Colloidal ^{32}P Labelled Chromium Phosphate with High Specific Activity, for Therapeutic Use). Constant Burg and André Chevallier (Inst. de Physique biologique, Strasbourg). 10p.

A new method for the preparation of colloidal P^{32}-labeled chromium phosphate is presented. It is based on the reduction of chromic acid in an anhydrous medium in the presence of labeled phosphoric acid at a temperature higher than 110°C. Ethyl alcohol is used as the reducer, and normal butanol is used as the reaction medium. The purification of commercial P^{32}, synthesis of chromium phosphate, and elimination of adsorbed soluble phosphates are described in detail. The yield is 80 to 90%. The characteristics of the colloidal solution of chromium phosphate are discussed. (J.S.R.)

6452 A/CONF.15/P/1232
DETERMINATION DES RENDEMENTS DE RADIOLYSE DE L'EAU PAR LES RAYONS α, A L'AIDE DU SYSTEME V^{V}/V^{IV}. (Determination of Yields in the Radiolysis of Water by α-Rays by Means of the V^{V}/V^{IV} System.) J. Pucheault and C. Ferradini (Univ. of Paris). 15p.

Under irradiation by Po^{210} α particles, the relative concentrations of VO_2^+ and of VO^{2+} in acid solution (0.8 N H_2SO_4) tend to concentrations corresponding to a stationary state between the oxidized and reduced forms. The initial rates of reduction or oxidation in absence of air, the rate of formation of peroxide VO_3^+, and the rate of appearance of gaseous products lead to the assignment of different values to the radical and molecular yields for the radiolysis of water by α rays. There is no particular agreement between these values and those calculated from the results for other solutes which, as a rule, do not agree among themselves. These disagreements have led to the hypothesis that, there should exist a well delineated region in which the following back-reactions take place: (a) $OH + H_2O_2 \rightarrow HO_2 + H_2O$; (b) $OH + H_2 \rightarrow H + H_2O$; and (c) $H + H_2O_2 \rightarrow OH + H_2O$. Upon this basis, one is able to explain why the radical and molecular yields depend on whether the system in solution, under the given experimental conditions, is a good scavenger for OH radicals (S_{OH}), H atoms (S_H) or both ($S_{OH,H}$). The G_a, G_b, G_c amounts which modify the yields are calculated by comparing various results with those obtained for vanadium. Using those G values, the calculated oxidation or reduction yields are found to be in agreement with the results concerning several solute systems (vanadium salts, ceric sulfate in presence and in absence of air, and ferrous sulfate in presence of air at various intensities, in absence of air, and in presence of copper). The maximum calculated yields for the decomposition of water is $G_{-H_2O} = 4.1$ (for $S_{OH,H}$). An attempt is made to give a physical interpretation of the origins of the suggested second region; the limitations of the theoretical treatment are discussed. (auth)

6453 A/CONF.15/P/1233
HETEROGENEOUS CATALYSIS IN RADIATION CHEMISTRY. M. Haissinsky and M. Duflo (Univ. of Paris). 9p.

The effects of small quantities (3 to 5 mg/cm^3) of various semiconductors on the radiochemical transformations produced by Co^{60} γ rays or 20-kev x rays (tungsten target) in aqueous solution were studied. Several experiments were also carried out with platinum black and palladium black. The results of oxidation of uranous sulfate and potassium iodide, and the reduction of ferric o-phenanthroline, and the bleaching of methylene blue are discussed. (auth)

6454 A/CONF.15/P/1235
PRODUCTION ET UTILISATION DES RADIOELEMENTS ARTIFICIELS EN FRANCE. (Production and Use of Radioisotopes in France.) C. Fisher and L. Cassin (Commissariat à l'Énergie Atomique, Paris). 16p.

The French radioisotope production program is described in some detail. The increase in the use of radioisotopes in industry since the 1955 Geneva Conference is discussed. Although the isotope production does not yet meet the national demand, the production rate is increasing. (J.S.R.)

6455 A/CONF.15/P/1262
PRINCIPAL RESULTS OBTAINED IN FRANCE IN STUDIES OF THE SEPARATION OF THE URANIUM ISOTOPES BY GASEOUS DIFFUSION. Claude Frejacques, O. Bilous, J. Dizmier, D. Massignon, and P. Plurien (Commissariat à l'Énergie Atomique, Paris). 8p.

The principal problems which occur in the study of uranium isotope separation by the gaseous diffusion process are the development and fabrication of satisfactory porous barriers, the preparation and purification of uranium hexafluoride, problems connected with its use (corrosion, vacuum technology, and gas-tight compression), development of mass spectrometers to measure concentrations of U^{235} and U^{238}, and the problems of chemical engineering with respect to the process and the optimum adjustment of relations between the stages. A brief description is given of the results obtained for the solutions of these problems. (J.S.R.)

6456 A/CONF.15/P/1287
HYDROCHLORURATION DU CAOUTCHOUC NATUREL DISSOUS SOUS L'ACTION DES RAYONNEMENTS IONISANTS. (The Addition of Hydrochlorides to Dissolved Natural Rubber under the Action of the γ Rays of Co^{60}). D. Stefanesco, Cl. Nicolau, and Eugénie Gârd (Inst. de Physique Atomique, Bucharest). 12p.

The effect of gamma radiation on natural rubber dissolved in carbon tetrachloride or monochlorobenzene was studied. As a result of the gamma irradiations hydrochloric rubber was obtained. Energies released by the radiation source, approximately 10^{18} to 10^{19} ev, were sufficient to bond the dissolved rubber. With these energies the reaction proceeds quantitatively to the formation of bonded hydrochloric rubber, which can not be obtained by any chemical method. (tr-auth)

6457 A/CONF.15/P/1308
UNE NOUVELLE MÉTHODE (PHOTOGRAPHIQUE) DE DOSAGE DES SOLUTIONS RADIOACTIVES α À L'AIDE DES EMULSIONS NUCLÉAIRES. (A New Dosage Method for Radioactive Solutions by Means of Nuclear Plates). Marieta Nicolae (Inst. de Physique Atomique, Bucharest). 15p.

A gelatin solution is mixed in known proportion with the radioactive solution. A thin layer of this solution supported on a glass plate is brought into contact with a nuclear plate, and the concentration of radioactive substance is determined from the number of tracks per unit area. (auth)

6458 A/CONF.15/P/1315
ETUDE SUR L'UTILISATION DES ARGILES ROUMAINES COMME ECHANGEURS D'IONS. DECONTAMINATION DES EAUX RADIOACTIVES. (A Study on the Use of Romanian Clays as Ion Exchangers). Gh. Ioanid, Gh. Mastacan, F. Bunus, M. Popesco, S. Stanciu, and A. Ciocănel (Inst. de Recherches Chimiques, Bucharest). 23p.

The behavior of some Romanian clays as ion exchangers for Sr^{90} and Cs^{137} was reviewed. A discussion is given of the research on the processing and regeneration possibilities of such clays as were found to be active. Their characteristics are further interpreted through a mineralogical study. (auth)

6459 A/CONF.15/P/1316
OXYDATION DE LA PARAFFINE TECHNIQUE ROUMAINE SOUS L'EFFET DES RADIATIONS DU Co^{60}.

(The Oxidizing of the Paraffins under the Action of Gamma Radiation). I. Drimus (Inst. Polytechnique, Bucharest), G. Ioanid, A. Dragut, P. Vasilesco (Inst. de Recherches Chimiques, Bucharest), and V. Dumitresco (Inst. de Physique Atomique, Bucharest). 29p.

A study was made of the effects of gamma radiation on the oxidizing reaction in various types of paraffins. The oxidation experiments were made at normal pressure and at temperatures between 130 and 150°C. The optimum dose for initiating oxidation was determined. The kinetics of the reaction were studied. The separation of the reaction products, variation in the conversion percentage with the dose, and methods of determining the relation between the dose and speed of reaction were also investigated. Particular attention was given to the low-volatility reaction products. The economic aspects of the reaction were also considered. (J.S.R.)

6460 A/CONF.15/P/1322
SOME STUDIES ON THE TRACER CHEMISTRY OF POLONIUM. Kenjiro Kimura and Tomitaro Ishimori (Atomic Energy Research Inst., Japan). 15p.

A summary is presented of studies on the tracer chemistry of polonium. The formation and composition of polonium dithizonate, polonium diethyldithiocarbamate, and polonium hydroxyluinolate are reported. The volatility of polonium compounds formed with various organic reagents was investigated. A method for the solvent extraction of polonium with isopropyl ether from hydrochloric acid solutions is given. It was confirmed that a carrier-free separation of Po^{210}, Pb^{210}, and Bi^{210} could be performed by ion exchange using hydrochloric acid and nitric acid as elutriants. A procedure for the distillation separation of Po^{210} and Bi^{210} is given. (J.S.R.)

6461 A/CONF.15/P/1323
RADIOCHEMICAL STUDIES OF FISSILE AND FISSION-PRODUCED ELEMENTS. Nobufusa Saito, Toshiyasu Kiba, and Kenjiro Kimura (Japan). 72p.

Recent radiochemical studies in Japan concerning fissionable and fission-produced elements are summarized. Separation procedures and the reactions involved are discussed. The procedures discussed are solvent extraction, ion exchange, coprecipitation, volatilization, electrolysis, and paper chromatography. Elements under consideration include Cs, Sr, Ba, Zr, Nb, Ru, Rh, Te, Sb, rare earths, and a few actinide elements, i.e., Th, U, and Np. Special attention is directed to Cs^{137} and Sr^{90}. (W.D.M.)

6462 A/CONF.15/P/1328
10,000 CURIE COBALT-60 IRRADIATION CAVE AT JAPAN ATOMIC ENERGY RESEARCH INSTITUTE. K. Kimura, A. Danno, M. Omura, H. Nomi, N. Shibata, N. Kanzaki, T. Matsumoto, and K. Ajioka (Japan Atomic Energy Research Inst., Tokyo). 17p.

An irradiation cave with a 10-kilocurie Co^{60} source for testing non-metallic materials used in reactors and for studies in radiation chemistry has been built at the Japan Atomic Energy Research Institute. The cave consists of three high-density concrete in-line cells with a wall thickness of one meter. The source consists of 110 Co^{60} rods from MTR. The dose rate at the center of the axis of the source cylinder can be varied in three steps, and its maximum value is approximately 2×10^6 r/hr. (W.D.M.)

6463 A/CONF.15/P/1350
EFFECTS OF γ-RADIATION ON POLYMER REACTIONS. Seizo Okamura, Tomonobu Manabe, Shigeru Futami, Tatsuo Iwasaki, Akio Nakajima, Kenji Odan, Hiroshi Inagaki, and Ichiro Sakurada (Kyoto Univ.). 52p.

Results are reported from an investigation of the effects of gamma radiation on polymer reactions. It was concluded that the polymerization process is initiated by primary radicals released from the monomer or the solvent by irradiation. The initiation depends on the number of radicals to be formed per 100 ev (G-value) of the radical-producing substances. The G-values of mixtures of benzene-chlorbenzene and of benzene-carbon were determined. The effect of air during irradiation is discussed for nylon, polyvinyl alcohol, dimethylsiloxane oil, and polymethylmethacrylate. (C.H.)

6464 A/CONF.15/P/1393
DETERMINATION OF GAMMA ISODOSE CURVES WITH PLASTIC SCINTILLATORS. R. Dugnani Lonati (Centro Informazioni Studi Esperienze, Milan) and G. Skoff (Clinica S. Ambrogio, Milan). 10p.

A method is proposed to determine the distribution of the dose by the luminous intensity produced in a plastic scintillator of a suitable density and shape so as to represent the actual development in an irradiated body section, and the possibilities as well as technical characteristics are described. A scintillating plastic sheet enclosed in a transparent plexiglass phantom is exposed to a Co^{60} bomb, and the progress of luminescence in the scintillator is photographed. The blackening produced on the photographic plate is examined by means of a microphotometer, and by comparison with the value obtained with an ionization chamber, a system of calibration of blacking-dose in rad is established. (auth)

6465 A/CONF.15/P/1422
ACCELERATION DES REACTIONS RADICALAIRES SOUS L'EFFET DES RADIATIONS IONISANTES. I. SYNTHESE DE L'ACIDE CYANHYDRIQUE A PARTIR DU METHANE ET DE L'AMMONIAC. (The Acceleration of Radical Reactions under the Action of Radiation). R. Mihail and J. Herscovici (Inst. de Recherches Chimiques, Bucharest). 17p.

The effect of ionizing radiations from Co^{60} on the reaction between methane and ammonia was studied between 500 and 950°C in the presence of a platinum catalyst. The reaction leads to the formation of HCN by a radical mechanism in the course of which the methyl and hydrazine radicals appear. By increasing the concentration of the active components, ionizing radiation increases the conversion of ammonia to HCN. (tr-auth)

6466 A/CONF.15/P/1439
RADIOCHEMICAL SEPARATIONS ON ANION EXCHANGE COLUMNS WITH EMPLOYMENT OF STRONG COMPLEXING AGENTS. T. Schonfeld, W. Wald, and Maria Bruno (Vienna Univ.). 19p.

Only a few investigations have been concerned with the use of strong complexing agents. Various radiochemical separations using anion-exchange resins and strong complexing agents are being studied. Results on several systems are reported, among them separations of $Pb^{210}-Bi^{210}$ and $Sr^{90}-Y^{90}$ using strongly basic anion exchangers and EDTA or other complexing agents. The special features of the application of strong complexing agents to radiochemical separations on anion exchange columns are discussed. (auth)

6467 A/CONF.15/P/1458
THE EXTRACTION OF ACTINIDE ELEMENTS FROM

WASTES. J. S. Nairn and D. A. Collins (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.), H. A. C. McKay (Atomic Energy Research Establishment, Harwell, Berks, Eng.), and A. G. Maddock (Cambridge Univ., Eng.). 55p.

As a result of the industrial production of uranium and plutonium, significant quantities of other actinide elements accumulate in wastes, and their recovery has aided investigation of their chemistry. This paper describes methods used to extract gram quantities of Th^{230}, Pa^{231}, and Np^{237} from relevant process wastes. The extraction of Am^{241} from highly irradiated plutonium is also described. (auth)

6468 A/CONF.15/P/1516
CHEMICAL CHANGES INDUCED IN ORGANIC SYSTEMS BY IONISING RADIATIONS. R. A. Back, W. Cooper, N. Miller, and W. H. Stafford (Edinburgh Univ.), E. A. Cherniak, E. Collinson, F. S. Dainton, G. M. Meaburn, and D. C. Walker (Univ. of Leeds, Eng.), and G. A. Swan, P. S. Timmons, and D. Wright (Univ. of Durham, Newcastle-upon-Tyne, Eng.). 31p.

The identification and measurement of the products in the radiolysis of benzyl alcohol, triethylamine, and chlorinated hydrocarbons are discussed. Attention is drawn to the potential utility as radical scavengers of compounds of the transition elements which are soluble in organic media and susceptible to oxidation or reduction by organic free radicals. Examples are given of the use of ferric chloride in solid and liquid systems. An account is given of the alpha radiolysis of some n-alkanes in the gas phase and it is pointed out that these systems are to some extent self scavenging; the unsaturated products which are initially formed reacting rapidly with free radicals and hydrogen atoms and thereby causing a marked change of product distribution with dose. (W.D.M.)

6469 A/CONF.15/P/1517
PRIMARY PRODUCTS IN THE IRRADIATION OF AQUEOUS SOLUTIONS WITH X- OR γ-RAYS. E. Hayon and J. Weiss (Univ. of Durham, Newcastle-upon-Tyne, Eng.), D. Armstrong (Univ. of Saskatchewan, Saskatoon, Can.), E. Collinson and F. S. Dainton (Univ. of Leeds, Eng.), and D. M. Donaldson and N. Miller (Edinburgh Univ.). 30p.

The aim of radiation chemical studies is to identify and to measure the yield of the various primary products which are formed under varying conditions. The results of indirect action on various solutes in dilute aqueous solution are presented and discussed. Solutes considered are single organic solutes (mono- and trichloroacetic acids), polymerizable monomer (acrylamide), formic acid, ferric and cupric ions, and oxygen. The results are broadly consistent with the diffusion theory of Magee and co-workers. (W.D.M.)

6470 A/CONF.15/P/1589
THE DEPOSITION OF TRACE AMOUNTS OF RADIOACTIVE CATIONS ON METAL SURFACES. J. Siejka and I. G. Campbell (Polish Academy of Sciences, Warsaw). 27p.

Work is reported on the investigation of the mechanism of sorption of tracer amounts of radioactive cation on various metal surfaces. Particular attention is paid to the phenomenon of the sorption of trace amounts of less noble cations on more noble metals, in which adsorptive processes are involved, rather than known processes involving the Nernst potential. Sorption isotherms and adsorption kinetics is reported for Sr^{90}, Zn^{65}, and Co^{60} on such metals as Al, Cu, Pb, Fe, and stainless steel. The effects of such factors as degree of dissolution of surface, pH, and nature of anion are also investigated. (auth)

6471 A/CONF.15/P/1617
ON THE MECHANISM OF OXIDATION OF AERATED FERROUS SULPHATE SOLUTIONS BY GAMMA RAYS. Yaacov Gilat and Gabriel Stein (Hebrew Univ., Jerusalem). 4p.

No agreement exists regarding the exact mechanism and relative importance of the elementary steps in the radiation-chemical oxidation of ferrous ions in aerated solutions. The dependence of the reaction of pH may furnish important information in this respect. Observations for the case where the pH was varied and the ionic strength was held constant and for the case where acid concentration was held constant and the ionic strength was varied are reported. (W.D.M.)

6472 A/CONF.15/P/1618
THE REDUCTION OF CYTHOCHROME C BY FREE RADICALS PRODUCED BY GAMMA RAYS. Shulamith Munk and Gabriel Stein (Hebrew Univ., Jerusalem). 5p.

In previous papers it had been shown that when oxygen-free aqueous solutions (10^{-5} M) of suitable acceptors such as methylene blue, coenzyme I, or cytochrome-C are irradiated in the presence of a large excess (1 M) of organic compounds complete reduction of the substrate can be obtained in high yield. Results are reported from an investigation of the quantitative aspects of the reduction of cytochrome-c in the presence of suitable organic substances, malate, lactate, beta-hydroxybutyrate, ethanol, succinate, glutamate, and alpha-glycerophosphate, as well as in the presence of molecular hydrogen. It was possible to show that the free radicals derived from organic compounds act as reducing agents on the cytochrome-c, and that the G-values of reduction obtained, the extent of the denaturation of cytochrome-c and the formation of new products from cytochrome-c depend on the nature of the organic substance added. Differences can be correlated with the structure of the organic molecule and the free radical derived from it in a specific manner. (auth)

6473 A/CONF.15/P/1619
THE RADIATION CHEMISTRY OF UNSATURATED HYDROCARBONS IN CHLOROFORM. THE SYSTEM CHLOROFORM–BIALLYL. I. Eliezer, H. J. G. Hayman, and G. Stein (Hebrew Univ., Jerusalem). 4p.

The reaction kinetics and the products obtained when oxygen-free chloroform solutions containing unsaturated hydrocarbon compounds are irradiated with x rays were investigated. In particular, the behavior of biallyl in chloroform was studied. It was shown that strictly zero order kinetics apply, by determination of the degree of unsaturation as a function of the total dose. In 1% solution, no evidence for chain reactions was obtained. After very high doses both double bonds of biallyl were found to have added chlorine containing radicals. The mixture of the chlorinated hydrocarbons thus produced has been studied by gas chromatography and fractional distillation. The elementary analysis of the fractions obtained is given and the formation of chlorinated teleomers discussed. (auth)

6474 A/CONF.15/P/1629
THE DESIGN AND CONSTRUCTION OF A RADIOCHEMISTRY LABORATORY SITED IN A TROPICAL AREA. G. R. Hall and H. D. Sharma (Atomic Energy Establishment, Trombay, India). 11p.

A radiochemistry laboratory was designed and constructed at the Atomic Energy Establishment, Trombay for the safe handling of tens of grams of plutonium, similar activities of other toxic alpha emitting materials, and multi-curie amounts of fission products. Despite several unusual features necessitated by the tropical climatic conditions in Trombay, the over-all cost of the laboratory is low by comparison with similar facilities in other countries. The main design features are described. (C.H.)

6475 A/CONF.15/P/1650
STUDY OF THE POSSIBILITY OF PREPARATION OF HIGH SPECIFIC ACTIVITY Co-60 THROUGH SZILARD-CHALMER'S REACTION. Amar Nath, Jagdish Shankar, and S. B. Srivastava (Atomic Energy Establishment, Trombay, India). 10p.

Several chelates of Cobalt (III) were studied. It was found that great care is necessary in the preparation and purification of the complexes so as to eliminate all traces of cobaltous impurities. The choice of the methods used for the separation of Co^{60}, along with Co(II) was guided by the ease of manipulation and the necessity to avoid decomposition of the irradiated complex during the process. The enrichment factor is profoundly influenced by the conditions of neutron irradiation, such as γ flux and temperature. It also depends on the time which elapses between irradiation and the chemical separation and the temperature at which the sample is stored. (auth)

6476 A/CONF.15/P/1700
LA SYNTHESE DES COMPOSES ORGANIQUES MARQUES. SYNTHESE CHIMIQUE ET SYNTHESE BIOLOGIQUE. (The Synthesis of Labeled Organic Compounds. Chemical and Biological Synthesis.) Y. Dalem-Simon (Belgium). 10p.

A brief bibliographic survey is presented of the synthesis of C^{14}-labeled sugars and cellulose as an introduction to the present work on the biosynthesis of each. The techniques used for the biosynthesis of glucose and cellulose are given. The steps in the synthesis of P^{32}-labeled glycerophosphate and glucose phosphate are described. (J.S.R.)

6477 A/CONF.15/P/1701
ANALYSE QUANTITATIVE DU THORIUM DANS LES MINERAIS ET LES PRODUITS THORIFERES PAR UNE METHODE BASEE SUR LA RADIOACTIVITE. (A Radioactivity Based Quantitative Analysis of the Amount of Thorium Present in Ores and Metallurgical Products). R. Collee, J. Govaerts, and L. Winand (Univ. of Liège). 15p.

A brief résumé of the classical methods of quantitative determination of thorium in ores and thoriferous products is given to show that a rapid, accurate, and precise physical method based on the radioactivity of thorium would be of great utility. A method based on the utilization of the characteristic spectrum of the thorium gamma radiation is presented. The preparation of the samples and the instruments needed for the measurements is discussed. The experimental results show that the reproducibility is very satisfactory and that it is possible to detect Th contents of 1% or smaller. (J.S.R.)

6478 A/CONF.15/P/1709
APPLICATION OF RADIOACTIVE ISOTOPES TO STUDY SOME PROBLEMS OF CHEMICAL KINETICS. (Application of Radioactive Isotopes to the Study of some Problems in Chemical Kinetics.) D. Gal, F. Dutka, L. Guczi, I. Kende, and M. Koch (Agrochemical Research Inst., Budapest). 10p.

Using the isotopes S^{35} and C^{14}, the oxidation mechanisms of styrene, hexane, thioglycolic acid, and acetaldehyde were examined. Isotopic exchange reactions in homogeneous and heterogeneous phases were studied by using I^{131}. For surface-structure studies, the kinetics of the desorption of ethyl, propyl, and butyl-iodide from red phosphorus and carbon were measured. (W.D.M.)

6479 A/CONF.15/P/1826
THE ACTION OF IONISING RADIATIONS (X-RAYS AND α-PARTICLES) ON AQUEOUS SOLUTIONS OF INDIGO-CARMINE. M. C. Anta, M. L. Roda Santos, and M. A. Paias (Instituto de Alta Cultura, Lisbon). 26p.

The effects of alpha particles and x radiation on aqueous solutions of indigo carmine were studied. Changes in absorption spectra show that both types of radiations induce qualitatively the same chemical effects. The influence of radiation dose, dye concentration, pH, oxygen concentration, and added solutes on the radioinduced bleaching was studied. The results are discussed in terms of free radical reactions. (C. H.)

6480 A/CONF.15/P/1956
LES MESURES DE LA RADIOACTIVITÉ ATMOSPHERIQUE PAR LES MÉTHODES CHIMIQUES ET RADIOMÉTRIQUES. (Identification of the Components of the Atmospheric Radioactivity through Chemical and Radiometric Methods.) L. Argiero, S. Manfredini, A. Olivi, and G. Palmas (C. A. M. E. N., Leghorn). 5p.

The methods used for the measurement of the radioactivity of rain and fall-out are described. An outline is given of the method used for chemical separation and radiometric determination of Sr^{90} in fall-out and rain. (J.S.R.)

6481 A/CONF.15/P/2020
ABSORPTION OF BETA PARTICLES IN SOLUTIONS. A. K. Hilmi and S. Abid Husain (Bagdad Pact Nuclear Centre). 6p.

The absorption of beta particles in three groups of different solutions, namely, acetates, chlorides, and nitrates was studied. The dependence of beta absorption on atomic number was found to apply to these solutions in the same way as it applied to pure elements and organic liquids. Identical absorption curves were obtained when plotted in terms of Z^{4}/A. The principle was used to determine the concentration of barium in barium acetate and of lead in lead acetate and lead nitrate. (auth)

6482 A/CONF.15/P/2022
STUDIES IN THE RADIATION CHEMISTRY OF AQUEOUS SOLUTIONS. M. A. Proskurnin and Y. M. Kolotyrkin (L. Y. Karpov Inst. of Physical Chemistry, U.S.S.R.). 37p.

It is generally considered that the yields of radiation-chemical reactions in aqueous solutions are determined by the initial formation of approximately 4 pairs of radicals (H + OH) per 100 ev. New data are presented which indicate that it is possible to involve short-lived particles in reactions (radicals, ions, and excited molecules) whose role should not be overlooked and whose reaction capacity proves to be considerable. Studying the reaction of oxidation of Fe^{2+} in a vacuum and in an atmosphere of N_2O is a compelling reason for giving up the generally accepted Krenz–Dewhurst's scheme. T. Rigg's, G. Stein's, and J. Weiss' assumption regard-

ing the oxidizing action of H_2^+ has not been confirmed in experiments on oxidation of Sn^{2+} and Ti^{3+} ions in a vacuum. The above contradictions are eliminated by the new assumptions. (auth)

6483 A/CONF.15/P/2086
ISOTOPE SEPARATION BY DIFFUSION IN A STEAM CURRENT. L. G. Gverdtsiteli, R. Y. Kucherov, and V. K. Tskhakaya (U.S.S.R.). 35p.

Experimental and theoretical investigations were made of the separation of isotopes by diffusion in a stream of auxiliary steam. From an analysis of the results it was concluded that the method can be used for separating the isotopes of a number of gases. The method is recommended for obtaining highly enriched isotopes. (C.H.)

6484 A/CONF.15/P/2095
DESIGN OF HIGH AND SEMI-LEVEL RADIOCHEMICAL FACILITY. Vojtěch Macháček, Mario Hubáček, Eduard Kos, Miloš Panýr, and Miloš Weber (Czechoslovak Academy of Sciences, Prague). 21p.

A radiochemical research center presently under construction is described. It consists of hot, semi-hot, alpha radiation, physical chemistry, and radiometric laboratories. A laundry for washing work clothes and containers for the collecting, checking, and subsequent treatment of radioactive wastes are also included. The position of the hot cells, their structural design, and the operation of individual cells are described. The system of vertical and horizontal transport of samples without the use of shielding containers is discussed. (W.D.M.)

6485 A/CONF.15/P/2096
KINETICS OF ADSORPTION OF A MIXTURE OF RADIOISOTOPES ON SURFACES. Z. Dlouhý and J. Malý (Czechoslovakia). 20p.

The theoretical relations are given for the kinetics of adsorption of a radioisotope mixture from solution on a solid surface. The time dependence of the amount of isotope A adsorbed can be described by a function containing two exponentials in the form $A = K_0 - e^{-K_1 t} - e^{-K_2 t}$. The adsorption of Zn^{65}, Po^{210}, and Ca^{45} on stainless steel was studied. (W.D.M.)

6486 A/CONF.15/P/2098
ISOLATION OF RADIOCESIUM BY DIPICRYLAMINE PRECIPITATION. V. Kouřím and J. Krtil (Czechoslovakia). 10p.

Cesium can be precipitated as dipicrylaminate from the group of alkalies containing ammonium. Cesium is separated from ammonium by ether extraction, and the dipicrylamine is regenerated by means of acidification. The method is suitable for separating cesium-137 from aged fission products. (C.H.)

6487 A/CONF.15/P/2109
A SIMPLE METHOD FOR DETERMINATION OF THE RADIOCHEMICAL PURITY OF ISOTOPES BY MEANS OF PAPER ELECTROPHORESIS. Miroslav Mach (Research Inst. of Radiology, Prague). 10p.

It was found that the electrophoresis on paper ensures a better separation of active contaminants than paper chromatography. Using the acid electrolytes, perchloric or nitric acid, an absolute separation of orthophosphate, sulfate, and chloride was achieved, i.e., of ionic forms, in which the impurities of radioisotopes S^{35}, Cl^{36}, and of irradiated chlorides as a result of production processes are present. Trace amounts of sulfates were separated from phosphates using diluted hydrochloric acid as electrolyte. The separation of radiotellurium from radioiodine was achieved only after the oxidation of samples using different electrolytes at the plus and minus electrode. Using the results of Zimakov et al., contaminating ruthenium from Sr and Y in 2% solution of potassium ferrocyanide and contaminating radiocesium from Sr^{90} in 0.5 N sodium hydroxide were separated by means of paper electrophoresis. (auth)

6488 A/CONF.15/P/2112
SYNTHESES OF SOME LABELLED COMPOUNDS OF BIOLOGICAL INTEREST. B. Chutný, A. Habersbergerová, P. Kouřím, J. Kučera, J. Morávek, O. Piták, J. Urban, and J. Zikmund (Czechoslovakia). 14p.

Procedures are described for the preparation of carbon-14 labeled compounds of interest as possible cancerostatic and bacteriostatic agents. In addition a number of compounds of biological and pharmacological interest were labeled with carbon-14 and sulfur-35. The compounds include derivatives of azauracil, azathymine, nitrouracil, crotonolactone, cycloserine, alanine, aminoethylisothiuronium, and thiospasmin. (C.H.)

6489 A/CONF.15/P/2114
RADIATSIONNAYA KHIMIYA VODNOGO RASTVORA KHLOROFORMA. (Radiation Chemistry of the Aqueous Solution of Chloroform). J. Teplý and J. Bednář (Czechoslovakia). 26p.

The chemical effects of ionizing radiation on the aqueous solution of chloroform and tetrachlormethane were investigated. Hydrochloric acid and carbon dioxide are the final products of the aqueous solution of chloroform and tetrachlormethane radiolysis. The dissolved oxygen is an important agent in the radiation reactions and increases the yield of HCl. The influence of HO_2 radicals on radiolysis was determined on the basis of the measured dependence of $G_{H_2O_2}$ on the chloroform concentration. The influence of the dissolved substances glucose, Tl^+, Fe^{2+}, Br^-, NO_2^-, and NO_3^- was studied. These studies revealed the role played by OH-radicals in radiolysis. A slight dependence of G_{HCl} on temperature and independence on the dose rate were found, and the influence of initial concentration of chloroform was determined. The yields of HCl were measured for x radiation of 150 and 60 kv, gamma radiation, beta radiation, and reactor radiation. The production of HCl is characterized by an induction period, the kinetic explanation of which is given. On the basis of the experiments, a mechanism of radiation reactions in the aqueous solution of chloroform and CCl_4 in the presence and absence of oxygen was elaborated. The linear dependence of the production of HCl on the radiation dose (ca. up to 10,000 r), independence on the dose rate, and considerable sensitivity make it possible to use the aqueous solution of chloroform as a laboratory chemical dosimeter. The evaluation of irradiated solutions by acidimetric titration is very rapid and reliable. (auth)

6490 A/CONF.15/P/2117
RADIATSIONNO-KHIMICHESKII RASPAD VODNYKH RACTVOROV NEKOTORYKH AMINOKISLOT. (The Radiochemical Degradation of a Number of Amino Acids.) J. Kopoldová, J. Koloušek, A. Babický, and J. Liebster (Czechoslovakia). 18p.

The radiochemical degradation of DL-methionine, DL-valine, DL-α-aminobutyric acid, and DL-lysine was studied. Aqueous solutions of these amino acids were

irradiated by different doses of x and γ rays. With methionine-S^{35} the decomposition effected by its own β rays was investigated as well. The radiochemical degradation of derivatives of DL-methionine, methioninesulfoxide, methioninesulfone, and methionine sulfoximine, was studied simultaneously. The amount of ammonia and of a number of degradation products as well as the decrease of the original amino acid was determined as a function of the irradiation dose. In the studies of the compounds from the degradation, the main interest was centered on the ninhydrin positive substances. These products were studied by paper chromatography and electrophoresis. The identity of some compounds was determined by isolation and infrared spectrography. After irradiation of a solution of DL-valine there were found 12 ninhydrinpositive compounds. Alanine, α-aminobutyric acid, aspartic acid, glutamic acid, and threonine were identified. These substances were found in the solution of irradiated α-aminobutyric acid as well. The solution of irradiated DL-methionine contained, besides the substances described elsewhere, these compounds: 5 ninhydrinpositive substances identified as alanine, threonine, serine, aspartic acid, and α-aminobutyric acid; and 22 products of acidic character containing sulfur. An analogy in the effects of x, γ, and β irradiation was found. (auth)

6491 A/CONF.15/P/2127
THE INVESTIGATION ON THE AMERICIUM CHEMISTRY. G. N. Yakovlev and V. N. Kosyakov (U.S.S.R.) 40p.

A number of methods are known for the separation of Am and Cm, including precipitation reactions and extraction and chromatographic methods. New data obtained during the study of some of these processes are presented and discussed. Some problems of the americium chemistry are examined, such as the solubility of low-soluble compounds, the composition and absorption spectra of crystals of double sulphates of Am(III) with alkali metals, and oxidation-reduction reactions occurring in Am solutions of different valences. The results of studies of the disproportionation reaction of Am(V), depending on acidity, acid anion, and temperature are given. Radiation-chemical processes in aqueous solutions due to high specific activity of Am^{241} are considered. (auth)

6492 A/CONF.15/P/2143
CHEMISTRY OF RADIORUTHENIUM. O. E. Zvyagintsev, V. D. Nikolskii (Nikolsky), et al. (U.S.S.R.). 24p.

Some Ru compounds of the general type $Me(RuNO(C_2O_4)_2)$ were synthesized, and some of their properties were studied. The process of electrical reduction of the compounds of $RuNOAc_2$ type were investigated, where Ac is the acid remnant. A study was made of the extraction capacity of various nitroso compounds of Ru by organic solvents at different acidity. (W.L.H.)

6493 A/CONF.15/P/2204
APPLICATION OF ION EXCHANGE FOR INVESTIGATION OF THE STATE OF RADIOACTIVE SUBSTANCES IN SOLUTIONS. B. Nikolskii (Nikolsky) and V. Paramonova (U.S.S.R.). 22p.

Reaction mechanisms in ion-exchange reactions in solutions are reviewed. Applications are discussed in quantitative determinations of ions of elements in solutions and in studies of the state of radioactive elements in solutions, especially in extremely dilute solutions. As examples the complex-forming processes are considered in systems of zirconium–nitric acid, uranyl–acetic acid, zirconium-95–perchloric acid–sodium perchlorate, and zirconium with nitrate ion and in mixtures of nitric acid and perchloric acid, in which zirconium-95 was present in microconcentration. Data are presented from studies on the interaction of radioyttrium ions with lactic acid complex ions and complex formation of uranyl ions in water solutions of sodium nitrate and sodium acetate and in acetate–nitrate solutions. (C.H.)

6494 A/CONF.15/P/2209
O PERSPEKTIVAKH ISPOL'ZOVANIYA OSKOLOCHNYKH ISLUCHATELEI V RADIOATSIONNO-KHIMICHESKIKH PROTSESSAKH. (Prospects of Using Fission Product Source Radiation in Radiation Chemistry.) P. V. Zimakov, A. V. Fokin, et al. (U.S.S.R.). 12p.

The method of obtaining hard fission product sources as castings of various shapes is outlined, in which the radioactive isotopes are tightly fastened on the carrier. The application of such sources of ionizing radiation to carry out chemical reactions is discussed. The method consists in concentrating and solidifying waste radioactive solutions and in subsequent fusing solid concentrates with various fluxes, so that sources of any shape may be obtained. The results of experimental research on the application of fission product sources in a number of chemical processes are described. (auth)

6495 A/CONF.15/P/2294
O MEKHANIZME SSHIVANIYA POLIMERNYKH TSEPEI POD DEISTVIEM γ IZLUCHENIYA. (On the Mechanism of Cross-Linking of Polymer Chains Under Gamma-Irradiation.) A. N. Pravednikov, Ying Sheng Kang, and S. S. Medvedev (U.S.S.R.). 9p.

In studying cross-linking processes in polyethylene caused by gamma radiation over a wide range of temperature, it was established that below the vitrification temperature T_v the cross-linking rate is temperature independent. The cross-linking of polymer chains resulting from the interaction of thermal hydrogen atoms depends on the degree of mobility of polymer chain segments and the reactivity of hydrogen atoms in the main or side chains. In polymer radiolysis, transfer reactions and recombination reactions are accompanied by the conversion of the tetrahedral structure into a plane structure. This conversion is easier if the polymer chain has side chains. For polymers with side chains no change in the cross-linking rate is observed when the temperature passes T_v. Heating of straight-chain irradiated polymers produces additional cross-linking. Partial destruction is observed when polystyrene is irradiated at 135°C or when it is pre-irradiated at room temperature and then heated to 140°C. (J.S.R.)

6496 A/CONF.15/P/2295
ISOLATION OF RADIOACTIVE FISSION ELEMENTS. N. E. Brezhneva, V. I. Levin, G. V. Korpusov, N. M. Manko, and E. K. Bogachova (U.S.S.R.). 42p.

To achieve group separation of radioactive fission fragments, the calcium oxalate precipitate was used with which radioactive strontium and rare earths coprecipitate. To ensure complete precipitation of strontium and rare earths that submit to different coprecipitation laws, a precipitation procedure was developed by which 98% of rare earths and strontium can be simultaneously separated on the precipitate, while zirconium, niobium, and ruthenium remain in solution. The calcium

oxalate precipitate cleaned from impurities by washing is dissolved in nitric acid and used as a raw material for separation of Sr, Ce, Y, Pr, Nd, Pm, and Eu. (auth)

6497 A/CONF.15/P/2339
THE IODINATION AND EXCHANGE OF MONOIODOTYROSINE. W. Zamudio and H. Behrens (Univ. de Concepción, Chile). 12p.

Results are reported from a study of the exchange of radioactive iodine and monoiodotyrosine in buffered aqueous solution. It was possible to obtain direct experimental evidence of this effect by a simultaneous reaction and exchange kinetics experiment. Labeled iodine was used, the iodinated organic derivatives were separated by ascending paper chromatography, and the individual spots were measured for radioactivity with a bell-type G-M counter. Results show the exchange rate to be dependent on the hydrogen ion and iodine concentration. Both these factors affect at the same time the rate of reaction of iodine and monoiodotyrosine. The concentration of iodine and monoiodotyrosine used were varied between 4.0×10^{-3} and 2.0×10^{-3} molar; the pH between 5.2 and 4.0. The specific activity of the initial iodine was also varied. (auth)

Separation Processes for Pu and U

6498 A/CONF.15/P/31
THE SIGNIFICANCE OF CERTAIN COMPLEXES OF RUTHENIUM, NIOBIUM, ZIRCONIUM AND URANIUM IN PLANT PROCESSES. P. G. M. Brown, J. M. Fletcher, C. J. Hardy, J. Kennedy, D. Scargill, A. G. Wain, and J. L. Woodhead (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 31p.

Solutions of fuels in nitric acid may contain a variety of ruthenium species, and methods for their identification and estimation in such solutions are presented. On the basis of laboratory investigations, the significance of the various species in solvent extraction processes (e.g., with dibutyl carbitol or tributyl phosphate as the solvent) and in related processes such as effluent treatment by precipitation, or by evaporation, are assessed and discussed. The complexing of uranium, zirconium, and niobium by tributyl phosphate and its degradation products arising from radiolysis or from hydrolysis has been examined and implications drawn as to the manner in which the formation of such complexes can affect zirconium and niobium decontamination factors in TBP separation processes. (auth)

6499 A/CONF.15/P/32
PROCESSING OF REACTOR FUELS BY LIQUID METALS. F. S. Martin, I. L. Jenkins, and N. J. Keen (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 8p.

When irradiated uranium is melted, the more reactive fission products are rapidly concentrated in surface skins by reaction with oxide or carbide impurities which are invariably present in the metal. A small amount of plutonium also tends to concentrate in the skin; this tendency can be prevented by melting in the presence of calcium metal, when the more reactive fission products, e.g., rare earth metals, dissolve in the calcium metal phase. Chemical aspects of this technique have been studied with plutonium–uranium alloy fuels such as might be used in a fast reactor. The distributions of various fission products between molten calcium and molten plutonium–uranium alloys have been determined. The alkali, alkaline earth, and rare earth metal fission products are extracted with very small losses of plutonium or uranium; the noble fission products are not extracted. (auth)

6500 A/CONF.15/P/82
CHEMICAL PROCESSES AT U.K.A.E.A. WORKS, DOUNREAY. C. Buck, G. R. Howells, T. A. Parry, B. F. Warner, and J. A. Williams (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). 53p.

Two chemical plants have been constructed at the Dounreay Works for processing irradiated uranium enriched in the 235 isotope. The fast reactor chemical plant is designed to process uranium elements containing only small proportions of alloying or stabilizing additions, while the experimental reactor plant will process fuel elements from experimental or research reactors in which the uranium has been alloyed with a large fraction of a diluting element. (auth)

6501 A/CONF.15/P/101
RESIN POISONS IN ION EXCHANGE RECOVERY PROCESSES. D. A. Everest, E. Napier, and R. A. Wells (Chemical Research Lab., Teddington, Middx., Eng.). 19p.

The poisoning of anion-exchange resins in uranium recovery plants may be considered as falling into two main categories: poisoning by ionic species and poisoning by ions which undergo polymerization-type reactions in the resin phase. The detailed poisoning mechanism is discussed. (W.L.H.)

6502 A/CONF.15/P/103
USE OF ELECTROCHEMICAL METHODS FOR REMOTE ANALYSES OF RADIOACTIVE SUBSTANCES OF THE VARIOUS STAGES OF REPROCESSING. Ph. Mechelynck (Centre D'Étude de l'Énergie Nucleaire. 14p.

It was deemed appropriate, while investigating the Purex process on a semi-pilot scale at Mol, to devise an electrochemical method for the separate determination of uranium, plutonium and some fission products. This method is particularly suitable for analyses to be performed by remote control, in which only the electrolysis cell must be in the hot area. A complete setup was developed, in which uranium and plutonium dosages are made by a polarographic method. For concentrated solutions, the accuracy achieved is of the order of a few percentage points; for very dilute solutions (of the order of some 0.1 Gm U/l), an acceptable precision of ten to twenty percent is obtained. A constant current electrolysis method is under study, in order to increase the precision achieved in the analysis of concentrated solutions. The tests carried out with equipment identical to that used for the polarographic dosage of uranium afford a means of reducing the error in dosage to three per thousand, for all concentrations greater than one gram of uranium per liter. The possibility of using a solid electrode rules out the difficulties due to the use of a mercury drop electrode. The method is currently being extended to the analysis of plutonium and some fission products. (auth)

6503 A/CONF.15/P/137
THE EXTRACTION OF PLUTONIUM AT VARIOUS OXIDATION POTENTIALS. Göran Carleson (AB Atomenergi, Stockholm). 16p.

The extraction of plutonium in tracer amounts by 40% tributyl phosphate (TBP), diluted in kerosene, from nitric acid solutions of varying concentration, either pure or containing small amounts of some oxidizing or re-

ducing agents was investigated. Distribution coefficients were determined for Pu(III), Pu(IV), and Pu(VI), and their partition curves were constructed. For acidities <2 M, higher valency states of Pu are rapidly and quantitatively reduced to Pu(III) by very dilute solutions of ferrosulfamate and hydroxylamine, while only a partial reduction is obtained with hydrazine. In higher HNO_3 concentrations, however, the process is much slower. The rate as well as the upper limit of acidity for a complete reduction was found to be a function of reducing conditions and shaking time. A slight increase of the upper limit can be obtained in certain mixtures of the reducing agents mentioned above. The stabilities of solutions of ferrosulfamate were found to decrease with increasing HNO_3 concentrations. A solution in 0.2 M HNO_3 is almost stable for at least one year, while a solution in 2 M HNO_3 rapidly deteriorates after a fortnight's storage. The reoxidation of Pu(III) to Pu(IV) was also investigated in varying concentrations of HNO_3 and NO_2^-. Increasing amounts of NO_2^- are needed with decreasing acidity, and the rate of the process is strongly dependent on the concentrations of the reactants. The redox processes mentioned above are discussed with regard to the oxidation of Fe^{+2} by HNO_3, to the stabilization of Fe^{+2} by sulfamate, and the destruction of the latter by HNO_2, and finally to the increasing content of NO_2^- in HNO_3 with increasing acidity. The oxidation of Pu(III) and Pu(IV) to Pu(VI) with strong oxidizing agents, such as BrO_3^-, was studied at different temperatures and acidities. The first oxidation step is rapid even at room temperature while the reaction Pu(IV) → Pu(VI) is slow even near 100°C and is also counteracted by the increasing amounts of NO_2^- at higher HNO_3 concentrations. The partition coefficients for pure HNO_3 to 40% TBP are also given. The mechanism of the extraction of Pu in different valency states is discussed, and it is shown that at equilibrium with a water phase of acidity <7 M, Pu is extracted to the organic phase as the neutral complexes $Pu(NO_3)_3(TBP)_3$, $Pu(NO_3)_4(TBP)_2$, and $PuO_2(NO_3)_2(TBP)_2$ in competition with the less strongly coördinated complexes $(HNO_3)(TBP)$ and $(H_2O)(TBP)$. (auth)

6504 A/CONF.15/P/144

SEPARATION OF PLUTONIUM FROM URANIUM BY PARTITION BETWEEN AN ORGANIC SOLVENT AND A STATIONARY WATER PHASE ADSORBED ON SILICA GEL. Å. Hultgren and E. Haeffner (AB Atomenergi, Stockholm). 11p.

A chromatographic method for the separation of plutonium from uranium was developed. A certain decontamination from extractable fission products is also obtained. Non-extractable fission products are separated in a primary extraction step which is carried out countercurrently in an extraction column. The conditions are adjusted so as to reach as quantitative an extraction of uranium and plutonium as possible and to give the highest possible decontamination of these elements from the fission products. At the same time the acidity of the organic product stream must not exceed a predetermined limit. The organic product stream is then passed downwards through a silica gel column, in which the silica gel has been packed in water or dilute nitric acid and the free water removed using pure organic solvent. Because of different partition coefficients, the uranium leaves the column quickly while the plutonium is practically fixed in the stationary water phase of the column. After a certain volume of primary organic solution has passed the column, the uranium left in the column is eluted with pure solvent, to which some nitric acid may be added. The plutonium is then eluted separately, either with a more acid portion of the organic solvent, or with nitric acid in water. The β-decontamination is better if the elution is carried out with organic solvent. It is possible to increase the capacity in each run considerably by loading the stationary water phase with a reducing agent to reduce the plutonium to non-extractable Pu(III) and thus fix it more effectively in the water phase. In this case, however, the plutonium can be eluted only with nitric acid in water. (auth)

6505 A/CONF.15/P/179

REFINING OF URANIUM CONCENTRATE AND PRODUCTION OF URANIUM OXIDE AND METAL. R. Gelin, H. Mogard, and B. Nelson (AB Atomenergi, Stockholm). 9p.

The processes used in Sweden for the production of uranium oxide and metal from uranous phosphate concentrate are presented. The refining process involves digestion of the uranous phosphate with caustic soda, conversion of the uranous hydroxide to ammonium uranyl carbonate, dissolution in nitric acid, and purification by solvent extraction using hexone. Ammonium uranate is recovered from the pure uranyl nitrate solution by homogeneous precipitation with urea. After calcination the UO_3 product is reduced to UO_2, converted to UF_4 in a "dryway" hydrofluorination process, and reduced by calcium to U metal, which subsequently is remelted under vacuum. (auth)

6506 A/CONF.15/P/307

THE CHEMICAL PROCESSING OF IRRADIATED FUELS FROM THERMAL REACTORS. G. R. Howells, T. G. Hughes, D. R. Mackey, and K. Saddington (United Kingdom Atomic Energy Authority, Sellafield, Cumb., Eng.). 49p.

The chemical plants located at the Windscale Works of the U.K. Atomic Energy Authority are designed to process natural or near-natural uranium fuels discharged from thermal reactors. The purpose is to separate the uranium and plutonium in pure forms from the associated fission products and from one another. This is accomplished by the use of solvent extraction methods after dissolution of the fuel rods in nitric acid. The organic solvents used at different stages of the process are dibutoxytetraethylene glycol ("Butex") and tributyl phosphate diluted with kerosene. The pure uranyl nitrate solution is returned to the Springfields Works for further treatment prior to re-enrichment and re-fabrication. The pure plutonium nitrate solution is converted to the metal billet form. The chemistry, chemical engineering, and engineering aspects of the existing plants and processes are described, and the experience gained as a result of some six years of operation is presented. (auth)

6507 A/CONF.15/P/468

THE ION-EXCHANGE OF URANIUM AND SOME FISSION PRODUCTS ON TITANIUM AND ZIRCONIUM PHOSPHATES. Ivan J. Gal and Olga S. Gal (Inst. of Nuclear Sciences "Boris Kidric," Belgrade). 17p.

The ion exchange of uranyl ions and some other cations on titanium and zirconium phosphates is investigated. Two inorganic cation exchangers are chosen because of their chemical and thermal stability as well as for their resistance to intense radiation. Due to these remarkable properties they are of special interest in the treatment of radioactive material. The synthesis of

the compounds and the preparation of the granular products used are described. First, the capacities of these exchangers and the distribution coefficients for some mono- and polyvalent cations are determined. Further, conditions for sorption and elution in column operation, especially for uranyl ion and ions of some long-lived fission products (Sr^{90}, Zr^{95}, Ru^{106}, Ce^{144}, Cs^{137}), are studied. Special attention is given to mutual separations. After a consideration of the results obtained, the possible applications of these inorganic ion exchangers for concentration and separation of some radioisotopes are discussed. (auth)

6508 A/CONF.15/P/484
ALKALINE LEACHING OF URANIUM FROM ASHES OF COAL. Milan Jovanić and Nikola Pacović (Inst. for Tech. of Mineral Raw Materials, Belgrade). 8p.

Research on ashes obtained by combustion of uranium-bearing coal at various temperatures has shown that solubility of uranium in Na_2CO_3–$NaHCO_3$ solutions decreases with increase of combustion temperature of coal. At high temperatures less soluble uranium compounds are formed which can be dissolved only with the aid of a higher concentration of reagents and at much higher temperatures of leaching. For this reason it is necessary to leach in such conditions ashes from thermal power plants in order to achieve a satisfactory leaching of uranium. The leaching of ashes obtained by combustion of pulverized uranium-bearing lignite in thermal power plants (combustion temperatures about 1,150°C) was investigated. Optimum conditions for separation of uranium, combustion temperatures of residual carbon in ashes, concentration of reagents, temperature, and time of leaching were also determined. Built up Na_2SO_4 reduces the ion exchange capacity and a procedure for its separation is proposed. (auth)

6509 A/CONF.15/P/488
SEPARATION OF LONG LIVED RADIOACTIVE ISOTOPES FROM A MIXTURE OF FISSION PRODUCTS AND CORROSION ELEMENTS. Milenko V. Šušić and Tatjana S. Selenić (Inst. of Nuclear Sciences "Boris Kidrič," Belgrade). 13p.

A procedure for the separation of the radioactive isotopes from fission product mixtures was developed. The separation of the radioactive ruthenium from nitrate solution was achieved by distillation, after addition of perchloric acid, and at the same time, evaporation of the solution. The residue was dissolved in hydrochloric acid and passed through a cation exchange column. Utilizing different concentrations of hydrochloric acid (from 0.1 to 6 N), the fission product mixture was divided into groups: group I, Mo; group II, Te; group III, Cs, Zr, and Nb; group IV, Sr; and group V, rare earths. Each of these groups contains some of the corrosion elements. Individual separation of radioactive isotopes from each group is done by the combination of anion and cation exchangers and also by the use of complexing agents. The possibility of using a thiocyanate complex for separation of the corrosion elements from radioactive isotopes on anion exchangers is considered. The possibility of separating uranium and some corrosion elements from a mixture of fission products is shown. The method includes the precipitation of their thiocyanate complexes with methyl violet from dilute hydrochloric acid solutions, before separation of the fission products into groups. (auth)

6510 A/CONF.15/P/585
THE JOINT ESTABLISHMENT FOR NUCLEAR ENERGY RESEARCH REPROCESSING PILOT PLANT. T. J. Barendregt and L. Koren Lund (Joint Establishment for Nuclear Energy Research, Kjeller, Norway). 6p.

A pilot plant for chemical processing of irradiated uranium has been erected at Joint Establishment for Nuclear Energy Research. A detailed description of the design of this installation and a report on operational experiences are presented. (auth)

6511 A/CONF.15/P/1002
SEPARATION OF THE URANIUM ISOTOPES BY THE NOZZLE PROCESS. E. W. Becker, K. Bier, H. Burghoff, O. Hagena, P. Lohse, R. Schütte, P. Turowski, and F. Zigan (Univ. of Marburg, Ger.). 15p.

Preliminary results on the separation of uranium isotopes by the nozzle process, which is based on the pressure diffusion in a free expanding jet stream, are reported. A description is given of the apparatus used, and the optimum operating conditions are determined. (J.S.R.)

6512 A/CONF.15/P/1113
AN ANALYSIS OF THE CHARACTERISTICS OF ANION EXCHANGE RESINS SUITABLE FOR THE URANIUM RECOVERY FROM ACID LEACH LIQUORS. R. E. Robinson, R. G. Velthuis, and E. T. Pinkney (Government Metallurgical Lab., Union of South Africa). 31p.

A brief outline of the ion exchange process for U extraction is presented with special reference to the aspects of interest in resin evaluation. The various properties of the resin which play an important role in the ion exchange operation are discussed in some detail. (W.L.H.)

6513 A/CONF.15/P/1116
EXPERIMENTS RELATING TO THE POSSIBLE PRODUCTION OF AN OXIDISING ACID LEACH LIQUOR BY AUTO-OXIDATION FOR THE EXTRACTION OF URANIUM. F. G. Neytzell-De Wilde and L. Taverner (Union of South Africa). 28p.

Investigations were carried out in the development of a process for the generation of sulfuric acid and ferric sulfate by the oxidation of sulfur dioxide with excess air in the presence of certain catalysts, namely, iron and/or manganese in solution. This work was initiated to meet the need for a cheap and convenient leaching solution containing both sulfuric acid and ferric sulfate. Experiment had shown such a liquor to be particularly suitable for the dissolution of the uranium minerals which occur in the Witwatersrand gold ores. The final method of production was essentially as follows. Sulfur dioxide was absorbed countercurrently in a tower, the packing of which was wetted with spent solution from the leach process from which the catalyst (iron) was obtained. The effluent solution was subsequently oxidized in a second tower with minute air bubbles introduced through a porous ceramic medium. The discharge from this tower contained the ferric sulfate and sulfuric acid at suitable concentrations for the leaching process. It was shown that the system could be operated on either a batch or a continuous basis, depending on the concentration of acid required. (auth)

6514 A/CONF.15/P/1117
A REVIEW OF THE CHEMICAL METHODS FOR THE

DETERMINATION OF URANIUM IN ORES, RESIDUES, AND PRODUCTS ARISING DURING PROCESSING. T. W. Steele and L. Taverner ([Government Metallurgical Lab., Johannesburg]). 40p.

A review is presented on the chemical methods used for the determination of uranium in ores, residues, and products arising during processing. The analytical methods are divided into methods of separation and determination. The separation methods discussed include precipitation, electrolysis and volatilization, chromatography, ion exchange, and solvent extraction. The determination methods include volumetric, coulometric, gravimetric, photometric, fluorimetric, and polarographic methods. 190 references. (J.S.R.)

6515 A/CONF.15/P/1121
THE ENRICHMENT OF URANIUM ISOTOPES WITH ULTRACENTRIFUGES. J. Kistemaker, J. Los, and E. J. J. Veldhuyzen (Foundation for Fundamental Research on Matter, Amsterdam). 10p.

The ultracentrifugation of UF_6 offers a promising method for an economical production of enriched U^{235} material. The fundamental theory of centrifuges is discussed, and the consequences with respect to constructional considerations and economical aspects are outlined. Results of chemical corrosion tests on various materials are given in connection with the discussion of the mechanical properties of the materials selected for use. (auth)

6516 A/CONF.15/P/1173
ETUDE DES COLONNES A PULSATIONS A L'AIDE DU SYSTEME NITRATE D'URANYLE–ACIDE NITRIQUE–EAU–TRIBUTYLPHOSPHATE. (Study of Pulsed Columns with the System. Uranyl Nitrate–Nitric Acid–Water–Tributylphosphate.) J. Durandet, D. Defives, B. Choffe, and Y. L. Gladel (Inst. Français du Pétrole, France). 28p.

The performance of a pulsed column with perforated plates was studied with the aid of a uranyl nitrate–nitric acid–water–tributyl phosphate system. The extraction of uranium from an aqueous acidic solution by an organic solvent and the extraction of uranium from organic solutions by water were the two cases investigated. The variation of the efficiency and the capacity of the pulsed column was determined as a function of the pulse amplitude and frequency, of the total flow rate, of the diameter of the holes, and of the choice of dispersed phase. The results showed that for a given amplitude and total flow rate the efficiency has a maximum with an increase in frequency. (J.S.R.)

6517 A/CONF.15/P/1174
PROBLEMS RAISED BY THE CONSTRUCTION OF THE PLUTONIUM EXTRACTION PLANT: SOME OF THE SOLUTIONS APPLIED AT MARCOULE. Curillon and Coeure (Compagnie de Saint-Gobain, France). 18p.

Solutions are described to the many problems raised by the building of the Marcoule plutonium extraction plant. The facility was designed to handle the irradiated fuel elements from G1, G2, and G3. A brief description of the process is given. The extraction building is divided into three leak proof areas with the administration offices being in another building. Some of the devices in the plant are described. (W.D.M.)

6518 A/CONF.15/P/1177
PROCEDE DE RETENTION ET DE RECUPERATION DE L'URANIUM DANS LES EFFLUENTS LIQUIDES. (Process for Retention and Recovery of the Uranium Contained in Liquid Effluents.) Pierre Pagny (Société Potasse et Engrais Chimiques, Paris). 15p.

A process is presented for the recovery of uranium from liquid effluents in the form of a rich concentrate. Uranium in effluents having a pH of at least 3 can be adsorbed at 80 to 90°C by passing the effluent over a filtrating bed composed of tribasic alkaline earth phosphates. The tribasic calcium phosphate or mixed alkaline earth phosphates, such as the double phosphate of calcium and barium or the products resulting from the hydrolysis of the components, is preferable for the filtrating bed. The pH of the effluents is a principal factor in the adsorptive properties of the bed. The effluents can also be freed of uranium by agitating them in the presence of a phosphate precipitate. The concentrate of uranium is then separated by filtration or decantation. Detailed results are given. (J.S.R.)

6519 A/CONF.15/P/1259
PREPARATION DE TETRAFLUORURE D'URANIUM A PARTIR D'UO_3 OU DE SEL D'URANYLE. Preparation of Tetrafluoride of Uranium from UO_3 or Uranyl Salts.) J. Sanlaville (Societe d'Electrochimie, d'Electrometallurgie et des Acieries Electriques d'Ugine, Paris). 11p.

The results obtained in the investigations on the simultaneous reduction and fluorination of UO_3, U_3O_8, uranyl fluoride, ammonium diuranate, and uranyl oxalate are presented. Hydrazine fluoride and ammonium bifluoride were used as the reducing and fluorination agents. The reagents are mixed with the powdered uranium compounds and heated in a nitrogen atmosphere at 100 to 200°C. The reaction products are collected and decomposed either under vacuum or in a nitrogen atmosphere. The mechanism of the reduction of uranium was not established with any certainty, but the minimum quantity of hydrazine fluoride necessary for complete reduction was 0.7 mole/g-atom of uranium. The UF_4 obtained is very pure, a minimum of 99.5%. It is very reactive. (J.S.R.)

6520 A/CONF.15/P/1260
PROGRES DANS LA FABRICATION DE L'URANIUM. LE CYCLE DU FLUORURE DOUBLE. (Improvement in the Manufacture of Uranium. Double Fluoride Cycle.) Michel Brodsky and Pierre Pagny (Société Potasse & Engrais Chimiques, France). 8p.

A procedure is described for the direct preparation of double uranium salts from uranyl nitrate solutions. The process is based on the reduction of the nitrate solution with formic acid and sulfurous anhydride in the presence of hydrofluoric ions. The reaction occurs rapidly at 90°C and is nearly quantitative. The double fluorides of uranium with sodium, potassium, or ammonium are perfectly crystallized and are easily separated from the liquid medium. They may be completely dried in air at 105°C without decomposing. Two types of continuous pilot-plant installations were tested successfully, and they are described. To manufacture uranium bars, the double fluoride of sodium can be reduced directly with calcium and magnesium. Tests have shown that the sodium content of the uranium obtained is quite satisfactory. (J.S.R.)

6521 A/CONF.15/P/1263
DETERMINATION DU FACTEUR DE SEPARATION DES ISOTOPES DE L'URANIUM PAR DIFFUSION GAZEUSE. (Experimental Values of the Separation Factor for Uranium Isotopes in the Gaseous Diffusion Process.) Oiegh Bilous and Georges Counas ([Commissariat à l'Énergie Atomique, Paris]). 21p.

A small twelve-stage gaseous diffusion cascade was

built for the measurement of the barrier separation factor for uranium isotopes. The experiments were performed in a wide range of operating conditions, with the mass flow rate of gaseous uranium hexafluoride at the separation inlet of the order of 1 g/sec under mean operating conditions. The experimental results are presented and compared with theory. Within the precision of the measurements, the theoretical values can be adjusted to the experimental data by choosing an adequate fictitious mean pore radius, different from the permeability pore radius, and an adequate value of the mass transfer boundary layer thickness. This adjustment, however, is not entirely satisfactory throughout the whole range of data. (J.S.R.)

6522 A/CONF.15/P/1268
REALISATION D'UNE CHAINE EXPERIMENTALE DE CONCENTRATION ISOTOPIQUE DE L'HEXAFLUORURE D'URANIUM PAR DIFFUSION GAZEUSE. (A Gaseous Diffusion Experimental Unit.). H. Albert (Societe de Recherches Techniques et Industrielles, Paris). 18p.

Results obtained from the operation of an experimental gaseous diffusion unit for the separation of uranium isotopes using uranium hexafluoride are presented. The criteria for the selection of various apparatuses for the unit are discussed, and the principal apparatuses chosen are described. The principal difficulties encountered in the set-up and operation of the unit are discussed briefly. (J.S.R.)

6523 A/CONF.15/P/1269
APPLICATION OF CONVENTIONAL TECHNIQUES TO THE CONSTRUCTION OF A PILOT PLANT FOR THE ISOTOPIC SEPARATION OF URANIUM BY GASEOUS DIFFUSION. G. Roubeix (Societe de Recherches Techniques et Industrielles, Paris). 12p.

The techniques presented are brought up to date according to the status of the knowledge when the pilot plant process was frozen at the end of 1956. The fundamental or applied research which went beyond this date is not included. Under vacuum techniques and surface techniques real leaks, desorption, chemical cleaning and degassing, and the pumping facility are discussed. The handling of UF_6 and measuring and regulating devices are discussed. (W.D.M.)

6524 A/CONF.15/P/1412
APPLICATION OF IONIC EXCHANGE TO THE RECOVERY OF URANIUM FROM SULFURIC DIGESTION SOLUTIONS OF THE MINERAL OF THE VENTA DE CARDEÑA, CORDOBA, SPAIN. B. López Pérez, A. Uriarte, M. Perarnau, and L. G. Jodra (Junta de Energia Nuclear, Madrid). 67p.

A study was made of the recovery of uranium from acid solutions produced by the attack of the Cardeña ore by sulfuric acid in the presence of Amberlite IRA-400 and Zerolitt-FF. A study also is presented of the effect of the duration of contact during the charging phase as well as of various eluants, comparing the chloride and nitrate systems, and finding the ideal conditions with the latter. A comparison also is made of the results obtained by a washing after charging, using demineralized water, with or without any sulfuric acid. A comparison is drawn of the results obtained with various bed heights and diameters, and the counting technique used as a check in all the tests is described. (auth)

6525 A/CONF.15/P/1413
PILOT PLANT INVESTIGATION ON THE PURIFICATION OF URANIUM CONCENTRATES BY TRIBUTYL PHOSPHATE EXTRACTION. L. Ramos, M. Berberana, A. P. Luña, and L. G. Jodra (Junta de Energía Nuclear, Madrid). 36p.

Some equilibrium diagrams of the concentration system of $HNO_3-UO_2(NO_3)_2-H_2O$–TBP in various conditions are given, and a study is made of the impurities most frequently encountered in the uranium concentrates. A description also is presented of the data obtained starting from a series of extraction and reextraction experiments carried out on the laboratory and pilot plant scales in refill columns. The experimental data are obtained as a function of variable concentration conditions regarding the water feed and output of both phases. (auth)

6526 A/CONF.15/P/1417
SELF-REDUCTION OF AMMONIUM DIURANATE TO URANIUM DIOXIDE. Jovino D. Pedregal and Roberto R. Solano (Junta de Energia Nuclear, Madrid). 10p.

The method is designed to transform ammonium diuranate into uranium dioxide without having to use any other agent as a reducer. It rests on the fact that this reduction can be achieved by the hydrogen produced by the dissociation of the ammonia released from the diuranate when heated. The final total reaction is $(NH_4)_2U_2O_7 \rightarrow 2UO_2 + N_2 + \frac{5}{3} H_2 + \frac{1}{3} O_2 + \frac{7}{3} H_2O$. By observing the quantity of NH_3 produced and consumed in the reaction, it is deduced that there is a 33.3% excess over and above the theoretical quantity required. (W.D.M.)

6527 A/CONF.15/P/1553
RECOVERY OF URANIUM FROM THE MALARGUE MENDOZA MINERAL BY IONIC EXCHANGE. Antonio A. Sufier and Alfredo E. Lagos (Comisión Nacional de Energía Atómica, Buenos Aires). 20p.

The liquids produced by the sulfuric leaching of the Malargüe uraniferous ore contain copper and sulfate in a concentration on the order of 1 Eq/l, as well as uranium, along with ten other elements, in concentrations which are of some 0.01 Eq/l each. The use of the conventional exchange techniques, on the laboratory scale, by means of a strong anionic resin afforded a means of absorbing 99% of the uranium contained in these liquids. The elution was carried out with a solution of ammonium nitrate in nitric acid and gave a solution containing approximately 1 mole/uranium per liter. Precipitation and calcination then yielded 98% pure U_3O_8. The uranium yield of the over-all process proved to be no less than 95%. A study was made of the effect of the pH of the absorption liquid on the capacity of the resin with respect to U and on the purity of the eluted liquid. A study also was made of the effect of the various techniques of operation on the purity of the uranium obtained. The conclusion was reached that the mineral can readily be treated by this method, and the details given of an analytic process designed for the rapid detection of the uranium in the absorption effluent, with a 5 to 10% breakthrough. (auth)

6528 A/CONF.15/P/1566
RECOVERY OF URANIUM FROM REJECTED LIQUIDS BY IONIC EXCHANGE. M. B. Crespi, A. A. Sufier, and E. G. Macchiaverna (Comision Nacional de Energia Atomica, Buenos Aires). 9p.

A description is given of a method for the recovery of the uranium contained in a filtrate of the uranium peroxide precipitation ($UO_4 \cdot H_2O$). As carried out in a

plant, this filtrate contains 100 to 300 mg U per liter at a pH of 2 to 3, with 1.3 volumes of H_2O_2. Under these conditions, the uranium is absorbed by strong cationic resins and eluted according to the reverse elution technique. This gives a high concentration factor for the uranium, and the efficiencies obtained are satisfactory. A possible theoretical interpretation of the process is presented. (auth)

6529 A/CONF.15/P/1605
THE ANION EXCHANGE OF METAL COMPLEXES. THE URANYL–PHOSPHATE SYSTEM. Y. Marcus (Israel Atomic Energy Commission). 19p.

The uranyl (M)–phosphate (A) complex system in acid solution was studied by an anion exchange method. Batch equilibrations of Dowex-1 phosphate resin (RA) with phosphoric acid (HA) and tripotassium phosphate-monosodium phosphate (3:1) buffer solutions provided data on uranium distribution and phosphate concentration. The activity of phosphate ions in the solution and in the resin was calculated, and "ideal" distribution values, derived from the data, were used by sweeping and "curve fitting" methods for a calculation of the complexity constants by successive approximations. These constants are illustrated by a "predominance area" diagram. The main species found are: MA^+, Ma_2, $M(HA)_2^{2+}$, MA_3^-, $M(A,2HA)^+$, and $M(HA)_3^{3+}$ in the solution, and RMA_3 in the resin. (auth)

6530 A/CONF.15/P/1607
SELECTIVE LEACHING OF URANIUM FROM PHOSPHATE ROCK BY DILUTE MINERAL ACIDS. I. Alter, E. Foa, Z. Hadari, G. Peri, and J. Trocker (Israel Atomic Energy Commission). 30p.

The present study deals with the separation, under suitable conditions, of uranium from carbonate containing phosphate ores by leaching with mineral acids. If calcined rock is treated with dilute acid, approximately 70% of the uranium, and only 15 to 20% of the phosphate pass into solution. Four factors have been found to influence the uranium extraction: the temperature of calcination, the state of oxidation of the uranium in the rock, the concentration of sodium in the rock, and the porosity of the rock. Satisfactory extraction of the uranium is achieved when the rock is calcined at 700 to 800°C under oxidizing conditions and in the presence of at least 1% of sodium ions. Neglect of any one of these factors leads to poorer uranium extraction. (auth)

6531 A/CONF.15/P/1608
A METHOD FOR THE REDUCTION OF URANIUM IN PHOSPHORIC ACID. A. Flaschenberg, J. Lavi, and J. Tulipman (Israel Atomic Energy Commission). 11p.

A new method for the reduction of uranium in phosphoric acid solution was developed and applied on a modest industrial scale. The method employs a galvanic system, an electrode couple having a potential difference of the order of 0.5v, and is used in 40% phosphoric acid. An iron electrode, short-circuited with stainless steel or a copper alloy, is placed in the acid solution against an inert platinum or stainless steel electrode. The speed of the reduction and the slope of the reduction curve depend only on the surface areas of the iron and the stainless steel, per unit volume of acid. In comparison with the method in which the uranium is reduced by dissolving iron, the galvanic reduction permits a considerable saving of iron. (auth)

6532 A/CONF.15/P/1609
THE ELECTRODEPOSITION OF URANIUM FROM MONOCALCIUM PHOSPHATE SOLUTION. PART I. I. Alter, E. Foa, Y. Marcus, and J. Trocker (Israel Atomic Energy Commission). PART II. A. Gruenstein, J. Lavie, I. Prulov, J. Tulipman, and A. Waldman (Israel Atomic Energy Commission). 40p.

When phosphate rock is leached by mineral acids under suitable conditions, about 80% of the uranium and 90% of the phosphate of the rock pass into solution, the latter as monocalcium phosphate. Electrolysis of this solution results in the deposition of about 90% of the uranium on the cathode. The mechanism of this electrodeposition is described, and the various factors which are expected to bear on the efficiency of the process are discussed. The methods for the stripping of the uranium deposits from the cathode are described. A survey is given of the results achieved with this method on industrial scale. (auth)

6533 A/CONF.15/P/1668
STUDIES ON THE PREPARATION OF PURE URANIUM TETRAFLUORIDE FROM CRUDE SODIUM DIURANATE. V. V. Dadape and N. S. Krishna Prasad (Atomic Energy Establishment, Trombay, India). 24p.

Crude sodium diuranate is converted to crude uranyl nitrate, the pH of the solution is adjusted to <3.0, and ammonium fluoride is added. The precipitated insoluble fluorides are filtered off, and the filtrate containing the complex fluorides of uranium and iron is treated with hydrogen peroxide and the pH adjusted to 6.5 to 7.0. At this pH the iron remains in solution. The precipitated ammonium uranium peroxyfluoride is filtered, washed, dried, and heated in a current of Freon-12 at 450 to 500°C to give uranium tetrafluoride. The preparation of the peroxy complex, the optimum conditions for the reaction between the peroxy complex and freon-12, and the nature and purity of the uranium tetrafluoride formed are described. (auth)

6534 A/CONF.15/P/2063
EXTRACTION OF URANIUM FROM NATURAL WATER. B. N. Laskorin, S. S. Metalnikov, and A. S. Terentiev (U.S.S.R.). 16p.

As the result of hydrochemical studies it was found that in a number of the largest natural water sources the uranium content is 2.0 to 67 mg/m^3. In some mine and oil waters the uranium concentration is 0.2 to 1.0 g/m^3. The extraction of uranium from natural waters of different salt contents by means of mineral or organic sorbents was studied. Natural sorbents, such as peat, bauxites, and iron ores were used. Gel phosphates of different metals including alumogels, ferrogels, titanogels, and ionites of different chemical composition, ensure quantitative extraction of uranium from natural waters. One can see a certain lowering of the sorption capacity of mineral gels and ion exchangers after reuse. A relation has been established between the chemical composition of natural waters and the type of the anion exchanger used. A method of coprecipitation of uranium from natural waters by means of different coprecipitators was developed and tested at a pilot plant. The concentration of uranium increased 80 to 160 thousand times. To extract the concentrate, different types of equipment, usually applied for water purifying (suspending and contact clarifying equipment, high speed filters, etc.), were used. The primary concentrate is dissolved in sulfuric acid; from this solution uranium is extracted either on carboxyl resin or on anion exchangers. The filtrate, containing the coprecipitator, is used as a proportioning solution for natural water treatment. (auth)

6535 A/CONF.15/P/2100
EKSTRAKTSIYA OBLUCHENNOGO URANA METILTSIKLOGEKSANONOM. (Extraction of Irradiated Uranium with Methyl Cyclohexanone.) V. Veselý, H. Beranova, and J. Malý (Czechoslovakia). 21p.

The use of a new solvent, methyl cyclohexanone, for the extraction of irradiated uranium in the system water–nitric acid–salting-out agent was investigated. The dependence of distribution coefficients of uranium and of beta and gamma activity of fission products on nitric acid, uranium, salting-out agent, and solvent concentration in equilibrium conditions was found. Comparison was made of the salting-out effect of ammonium, aluminum, and sodium nitrates. In the case of ammonium nitrate the distribution coefficients of uranium and beta and gamma activity with those of tributyl phosphate in similar conditions were compared. It is true that in the case of aluminum nitrate higher distribution coefficients of uranium were found, but at same time a less effective separation of uranium from the fission products was achieved. The results obtained in the case of ammonium nitrate are comparable with results of tributyl phosphate extraction. (auth)

6536 A/CONF.15/P/2122
SEPARATION OF URANIUM IN CHLORIDE–NITRATE MEDIUM. M. Novák and V. Pekárek (Czechoslovakia). 13p.

An extraction of a uranium ore containing calcium carbonate with the aid of a surplus of a mixture of hydrochloric and nitric acids in different concentrations and digestion time was carried out. The separation was carried out by means of Czechoslovak strong basic anex L of the lutidine-formaldehyde type in nitrate cycle. Uranium was separated from the elements of the first and second groups, aluminum, iron, lead, zinc, rare earths, etc. The separation was carried out not only in a mixture of hydrochloric and nitric acids, but also in a medium of corresponding calcium salts. (auth)

6537 A/CONF.15/P/2182
SOME PECULIARITIES IN TREATING IRRADIATED FUEL ELEMENTS AT THE FIRST ATOMIC POWER STATION IN THE U.S.S.R. V. B. Shevchenko, N. S. Povitskii (Povitsky), and A. S. Solovkin (U.S.S.R.). 10p.

Some features of processing irradiated fuel elements at the first atomic power station in the U.S.S.R. are presented. It is impossible to remove mechanically a stainless steel can from the surface of the fuel element. Therefore, to remove a can partially the atomic fuel element is cut in the transverse direction into pieces ≥ 10 mm long by a special device. The dissolution of the alloy in nitric acid takes place in an inert gas atmosphere. Additional chelating agents are used to prevent the formation of sediments when atomic fuel is being dissolved. Uranium and Pu(IV) are extracted from nitric acid solutions by 20% tri-n-butyl phosphate solution. To increase the uranium distribution ratio, extraction may be carried out at low temperatures. If fuel elements are to be processed without prolonged cooling, then deposition procedures are used for the initial (preliminary) separation of uranium and plutonium from macro–contaminants and fission products. (auth)

6538 A/CONF.15/P/2206
RASPREDELENIE OSKOLOCHNYKH ELEMENTOV V PROTSESSE EFIRNOI EKSTRAKTSII. (Distribution of Fission Products in Ether Extraction Process.) V. M. Vdovenko (U.S.S.R.). 12p.

The results of studies on fission product behavior in extraction of uranium and plutonium by diethyl ether and a mixture of dibutyl ether with carbon tetrachloride are presented. The difference between the uranium and plutonium distribution coefficients on the one hand and those of the fission products on the other ensures considerable purification of nuclear fuel. The fission products most difficult to separate are ruthenium and zirconium, which pass easily into the organic phase. The presence of these elements accounts for a considerable part of activity displayed by uranium and plutonium in the process of their purification. Most of the elements which are present as impurities in the process solutions have small distribution coefficients and are removed during the extraction. (auth)

6539 A/CONF.15/P/2216
OTDELENIE URANA I PLUTONIYA OT PRODUKTOV DELENIYA EKSTRAKTSIEI SMES'YU DIBUTILOVOGO EFIRA I CHETYREKHKHLORISTOGO UGLERODA. (Separation of Uranium and Plutonium from Fission Products by a Mixture of Dibutyl Ether and Carbon Tetrachloride.) V. M. Vdovenko and M. P. Koval'skaya (U.S.S.R.). 11p.

A description is given of an extraction technique for processing irradiated uranium. The solvent is an explosion-proof mixture of dibutyl ether and carbon tetrachloride. After coextraction of hexavalent uranium and plutonium nitrates so that the bulk of fission elements remains in the aqueous waste solution, plutonium is separated from uranium by reductive re-extraction. Further purification of plutonium is carried out in a 2-cycle extraction–re-extraction process. The separation of uranium from fission products is carried out in a 1-cycle operation. Uranium recovery yield is 99.9%; plutonium yield is 98%. (auth)

6540 A/CONF.15/P/2253
SUKHOI METOD REGENERATSII OBLUCHENNOGO URANA. (Dry Method of Regeneration of Irradiated Uranium by Gaseous Fluorine.) V. N. Prusakov, N. F. Simonov, and N. M. Trotsenko (U.S.S.R.). 13p.

Studies carried out to develop a method of recovering irradiated uranium by gaseous fluorine are reported. (tr-auth)

6541 A/CONF.15/P/2293
RADIOLIZ I RADIATSIONNOE OKISLENIE ORGANICHESKIKH SOEDINENII. (Radiolysis and Radiation Oxidation of Organic Compounds.) N. A. Bakh, V. I. Medvedovskii, and V. V. Saraeva (U.S.S.R.). 19p.

Data are presented on the radiation effects on extraction of plutonium by simple ethers from aqueous solutions and radiation-induced transformations in pure ethers and aqueous solutions. (R.V.J.)

6542 A/CONF.15/P/2346
PURIFICATION ET CONCENTRATION FINALES DU PLUTONIUM EN FIN DE TRAITEMENT DE L'URANIUM IRRADIE A L'USINE-PILOTE DE FONTENAY-AUX-ROSES. (Purification and Final Concentration of Plutonium at the End of the Treatment of Irradiated Uranium at the Pilot Plant of Fontenay-aux-Roses.) I. Prevot, J. Corpel, and P. Regnaut (Commissariat à l'Énergie Atomique, Paris). 38p.

A method is given for the concentration and purification of plutonium which has already had a primary extraction with TBP, followed by a reducing reextraction.

The method consists of three parts: (1) a new solvent extraction of plutonium followed by a reducing reextraction, which improves the decontamination of fission products, (2) passage of the solution obtained on ion exchange resins, which gives a concentrated solution of very pure plutonium, and (3) precipitation of plutonium trifluoride which is used for the production of the metal. The theoretical study which led to the establishment of the procedure is discussed. A detailed description is given of the process along with some of the practical results obtained. (J.S.R.)

6543 A/CONF.15/P/2412

PARTITION OF URANIUM AND THORIUM BETWEEN SOLUTIONS OF NITRIC AND PERCHLORIC ACIDS AND FOUR ORGANIC SOLVENTS. M. Branica and E. Bona (Inst. Ruder Bošković, Zagreb). 12p.

The extraction of uranyl and thorium ion by cyclic ethers is described. The extraction procedures with cyclic ethers are analogous to those of alcohols, ketones, and ethers, where salting agents are required. Extraction equilibria of uranyl and thorium nitrates and perchlorates were determined. The partition was investigated by tetrahydrosylvane (THS), tetrahydropyrane (THP), 2-ethyl-tetrahydrofurane (E-THF), and 2,5-dimethyl-tetrahydrofurane (M-THS) in various concentrations of nitric and perchloric acid. (auth)

6544 A/CONF.15/P/2413

THREE-DIMENSIONAL PRESENTATION OF PRECIPITATION OF URANYL ION IN AQUEOUS SYSTEM OF SODIUM CARBONATE AND BARIUM CHLORIDE. B. Težak, H. Füredi, and M. Branica (Inst. Ruder Bošković, Zagreb and Univ. of Zagreb). 12p.

Equal volumes of sodium carbonate and barium chloride solutions of varying concentrations were mixed. The systems were kept at 25°C for 24 hours and then filtered. The quantity of precipitated uranyl ion was determined polarographically. Electron microscope photographs illustrate the appearance of the complex precipitate. (W.D.M.)

6545 A/CONF.15/P/2466

SOME EXPERIMENTS ON THE SOLVENT EXTRACTION OF SLURRIES. Rasit Tolum (Turkey). 6p.

The breakdown rate of emulsions as a function of temperature and pH of the system was investigated. Synthetic slurries consisting of finely-ground quartz and an aqueous solution either acidified with HCl or alkalinized with NaOH were used. The organic phase consisted of TBP and di-ethylhexyl phosphoric acid in kerosene. It was found that temperature increase improves phase disengagement and aids in the destruction of the unstable emulsion. Also, an increase of hydrogen ion concentration improves the action of the solvent-slurry extraction. The principles of flotation and of emulsion formation in slurries are discussed. (J.R.D.)

CONTROLLED THERMONUCLEAR PROCESSES

6546 A/CONF.15/P/1

HYDROMAGNETIC DISTURBANCES OF LARGE AMPLITUDE IN A PLASMA. J. H. Adlam and J. E. Allen (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 12p.

Calculations were made pertaining to the rapid compression of a plasma containing a magnetic field under conditions where collisions can be neglected. (auth)

6547 A/CONF.15/P/2

THEORETICAL PROBLEMS SUGGESTED BY ZETA. W. B. Thompson, J. Hubbard, and S. J. Roberts (Atomic Energy Research Establishment, Harwell, Berks, Eng.), and S. F. Edwards (Univ. of Birmingham, Eng.). 21p.

The consequences of the hypothesis that Zeta has produced a pinched discharge stabilized by a trapped axial field are explored. What happens when the stability condition is violated is considered. The transport coefficients which have a vital role in the heating of the discharge and in preserving the stable configuration are discussed. (W.D.M.)

6548 A/CONF.15/P/3

REVIEW OF CONTROLLED THERMONUCLEAR RESEARCH AT A.E.I. RESEARCH LABORATORY. T. E. Allibone, D. R. Chick, and A. A. Ware (Associated Electrical Industries, Ltd., Aldermaston, Berks, Eng.) and G. P. Thomson (Cambridge Univ., Eng.). 32p.

The research work reviewed was initiated at Imperial College, London University in 1946, and was moved to the A.E.I. Research Laboratory in 1951. The method of approach to produce the required high temperatures has always been the toroidal pinched discharge. Following initial studies of this type of discharge, attempts were made to produce a reaction by extending the work to currents of the order 10^5 A. This early work (1951) failed for two reasons, firstly because of the magneto-hydrodynamic instabilities of the discharge and secondly because of vaporization of the discharge tube wall. Most of the research at A.E.I. has been directed at solving these two problems. (auth)

6549 A/CONF.15/P/33

THE STABILITY OF A CONSTRICTED GAS DISCHARGE. R. J. Tayler (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 35p.

Theory predicts the existence of stable configurations of hot highly conducting plasmas confined by strong magnetic fields. Such known configurations make stringent demands on the strength and disposition of the magnetic fields. As dissipative processes are never completely absent, any such stable configuration will not be stationary even if it can be physically realized instantaneously. The role of the transport processes is thus twofold; they may prevent the desired configuration from being reached, especially if the final temperature is achieved slowly, and they will cause gradual mixing of magnetic fields once the desired arrangements has been set up. Accurate estimates of the magnitude of these effects depend on a knowledge of transport coefficients in high magnetic fields and high field gradients. A first consideration of the problem of duration of stability can be divided into two parts: firstly the rate of penetration of magnetic fields can be estimated from the transport coefficients, secondly the stability of successive configurations can be studied assuming infinite electrical conductivity. At the same time it may be possible to study a simple stability problem in which the effect of finite transport coefficients is considered. An account is given of some aspects of this problem. (auth)

6550 A/CONF.15/P/34

THE ROLE OF MATERIALS IN CONTROLLED THERMONUCLEAR RESEARCH. J. L. Craston, R. Hancox, A. E. Robson (Atomic Energy Research Establishment, Harwell, Berks, Eng.), and S. Kaufman, H. T. Miles, A. A. Ware, and J. A. Wesson (Associated Electrical Industries, Ltd., Aldermaston, Berks, Eng.). 33p.

In any practical device the magnetic isolation will not

be perfect and the walls will also be bombarded by energetic charged particles. Under these conditions wall material may be evaporated into the plasma. The problems of wall erosion are discussed, with particular reference to a reactor based on the pinch effect. Experience gained in experiments with high current discharges in toroidal tubes is included. A theoretical comparison is made of the evaporation from a wide selection of materials under steady and pulsed heat inputs. In general, metals give least evaporation. Sputtering is not a serious cause of erosion in present apparatus but it is shown that it may become more serious under certain conditions. Other considerations affecting the choice of materials such as chemical stability, and neutron and radiation-absorbing properties are briefly discussed. (auth)

6551 A/CONF.15/P/78
CONTROLLED THERMONUCLEAR RESEARCH IN THE UNITED KINGDOM. P. C. Thonemann (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 13p.

The objectives of the U.K. controlled thermonuclear research program are stated and reasons given why such objectives are desirable. The physical principles underlying the practical application of thermonuclear power are outlined. The different approaches studied in the U.K. are discussed together with the reasons why the main effort was concentrated on a study of the pinch effect method of gas containment. A brief historical account of research is given dating from the time when the project was given government support in 1948. The problems which must be solved fall into six categories, namely, plasma physics, theoretical physics, atomic physics, materials, electrical technology, and organization. Examples of typical problems are given including the development of new instruments and measuring techniques. The future prospects and lines of development are indicated leading finally to a reactor using pure deuterium as a fuel which generates electrical power directly. (auth)

6552 A/CONF.15/P/145
MAGNETO-HYDRODYNAMICS AND THERMONUCLEAR PROBLEMS. H. Alfvén (Royal Inst. of Tech., Stockholm). 5p.

There are two different requirements for a thermonuclear reactor: (a) a plasma should be heated to a very high temperature and (b) the heated plasma should be confined during a sufficiently long time. In experiments of the ZETA type both these effects are produced in the same volume. From some points of view it may be an advantage to heat the gas in a volume which is separated from the volume where it is ultimately confined. This may be achieved by shooting a heated and magnetized plasma between cylindrical or conical electrodes towards a transverse magnetic field, which may be trapped by the plasma in such a way that one obtains a ring with a longitudinal magnetic field enclosed by an external field threading the hole in the ring. Theoretical and experimental investigations about the possibility of forming a plasma ring in this way are reported. Different methods to heat the plasma to extremely high temperatures are discussed. (auth)

6553 A/CONF.15/P/146
DIFFUSION PROCESSES IN THE POSITIVE COLUMN IN A LONGITUDINAL MAGNETIC FIELD. B. Lehnert (Royal Inst. of Tech., Stockholm). 35p.

Diffusion caused by binary collisions in an ionized gas is known to be reduced by a strong magnetic field. An experimental verification of collisional diffusion was performed with a discharge tube having a length of about four meters and a cross section of two centimeters in a longitudinal magnetic field in the range 0 to 5000 gauss. The diffusion coefficient is determined by measurements of the potential drop in the positive column, the pressure, the current through the tube, and the magnetic field. (auth)

6554 A/CONF.15/P/147
TOROID DISCHARGES IN DEUTERIUM WITH EXTERNAL MAGNETIC FIELD. Kai Siegbahn and Per Ohlin (Inst. of Physics, Uppsala). 7p.

Some experimental work is described which concerns two different ways of obtaining a constricted ring discharge in deuterium at about 0.01 mm Hg. In one type of experiment a constant external magnetic toroid field is applied, and an E centered pinch is formed by means of discharging a condenser bank of 60 μf at about 35 kv. In a second type of experiment a very large bank of condensers is used giving a stored energy of about 1 million joules, which induces a variable toroidal magnetic field with a time constant of about 1 msec. This produces an H centered pinch. (auth)

6555 A/CONF.15/P/1056
REPORT ON SOME RECENT WORK IN THE FIELD OF CONTROLLED THERMONUCLEAR FUSION DONE IN GERMANY (FEDERAL REPUBLIC). L. Biermann (Göttingen). 8p.

Experiments performed at Göttingen, Munich, Aachen, and Stuttgart on electric discharges with high current densities in relation to the problem of controlled fusion are described. Experiments were performed on both linear and toroidal discharge. Theoretical work discussed includes basic considerations, methods of heating, configurations in magnetohydrostatic equilibrium, stability, particle losses by drift motion, and magnetohydrodynamic shock waves. (W.D.M.)

6556 A/CONF.15/P/1181
EXPERIMENTAL STUDIES ON THE STRICTION PHENOMENON. R. Aymar, C. Etievant, P. Hubert, A. Samain, B. Taquet, and A. Torosian (Commissariat à l'Énergie Atomique, Paris). 24p.

Experimental work on the production and stabilization of the pinch effects is described. The experiments were on rapid rectilinear discharge and ring shaped discharges. Equipment is described and electrical, spectroscopic, and x-ray observations are discussed. (W.D.M.)

6557 A/CONF.15/P/1182
DECHARGES A FORTE INTENSITE DANS LE DEUTERIUM DANS UN TORE A PAROIS METALLIQUES. (Realization and Study of High Intensity Electric Discharge in Aluminum Torus). J. Andreoletti, C. Breton, J. Charon, P. Hubert, Ph. Jourdan, and G. Vendryes (Commissariat à l'Énergie Atomique, Paris). 15p.

The production and study of a high-intensity discharge in a torus made of aluminum are described. The discharge chamber and the rest of the experimental arrangement are described in detail. Preliminary results showed that it is possible to ignite in an Al torus a high-intensity discharge in deuterium. The shape of the intensity and voltage curves are not incompatible with a good stability of the discharge obtained. The intensities found support the supposition that a high-temperature was obtained. (J.S.R.)

6558 A/CONF.15/P/1183
AUTOMATISATION DES CALCULS NON LINEAIRES

DANS LA THEORIE DES REACTEURS A FUSION. (Automatisation of Non Linear Calculations in the Theory of Fusion Reactor.) Paul Braffort and Michel Chaigne (Commissariat à l'Énergie Atomique, Paris). 33p.

A series of techniques is presented which allow a great extension of the range of application of analog calculation in the framework of theoretical studies of fusion reactors. Although, in all the cases studied, techniques of arithmetical calculation are usable, it is not necessary to use them as high precision is not desired since the physical magnitudes are poorly known. Also, at the present stage of investigation, it is necessary to vary the parameters to a great degree and this is quite easy with the analog method. The procedures described permit a transfer to linear approximations. (J.S.R.)

6559 A/CONF.15/P/1184
EVOLUTION ENERGETIQUE THEORIQUE D'UN PLASMA THERMONUCLEAIRE DE DEUTERIUM ET DE DEUTERIUM–TRITIUM. (Changes Brought About in Thermonuclear Mixtures of DT and DD According to the Temperature of the Tritium Concentration.) D. Magnac-Valette, E. Lacombe, and P. Cuer (Univ. of Strasbourg). 8p.

Taking account of secondary reactions, the energy liberated by each reaction was determined and the contribution of each examined. This work shows up the importance of the helium-3 concentration for temperatures of the order of 500 million degrees. (auth)

6560 A/CONF.15/P/1307
PLASMA OSCILLATIONS IN A STEADY-EXTERNAL MAGNETIC FIELD. S. Ciulli (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.) and M. Micu (Inst. de Physique Atomique, Bucharest). 7p.

By using a statistical method the behavior of electrons from a plasma in an external-steady magnetic field is studied. The electromagnetic mode of electron-oscillations, normal to the magnetic field and to the propagation direction is independent of the electrostatic mode and of the electromagnetic mode with the polarization contained in the plane formed by the magnetic and the propagation vector. The two last oscillations-modes are coupled. In order to avoid singularities the elimination method of Van Kampen is used. The results may be extended to a plasma in a self-magnetic field (electrical discharge). (auth)

6561 A/CONF.15/P/1329
PROPOSED METHODS OF OBTAINING STABLE PLASMA. G. Miyamoto, T. Kihara, G. Iwata, S. Mori, T. Ohkawa, and M. Yoshikawa (Tokyo Univ.). 8p.

Two possibilities of obtaining stable plasmas of high temperatures, induction pinch effect and spatial pinch effect, are discussed. (W.D.M.)

6562 A/CONF.15/P/1330
CYCLOTRON RADIATION FROM A MAGNETIZED PLASMA. S. Hayakawa, Y. Terashima, and T. Tsuneto (Kyoto Univ.), and N. Hokkyō (Hitachi Central Inst., Tokyo). 8p.

Cyclotron radiation and its inverse process are discussed. The width of the cyclotron resonance is calculated by taking into account the electron collision and the randomness of magnetic fields. The theory of irreversible processes is applied to such calculations. The correlations among these and other possible modes are also considered. The results are applied to astrophysical problems, such as the solar radio emission and the absorption of celestial radio waves. Methods of observing the properties of a plasma in laboratory experiments are suggested. (auth)

6563 A/CONF.15/P/1368
SUR LA POSSIBILITÉ D'OBTENIR DES RÉACTIONS DE FUSION AVEC UN SYSTÈME DE FOCALISATION 4π. (On the Possibility of Obtaining Fusion Reactions In 4π Focusing Systems.) G. Barsanti, B. Barsella, M. Camerini, U. Federighi, L. Musumeci, and N. Talini (C.A.M.E.N., Livorno, Italy). 9p.

The idea, suggested by G. Miyamoto et al. (J. Phys. Soc. Japan 12, 438(1957)), of utilizing a 4π focusing electromagnetic spectrometer for producing nuclear fusion reactions was developed together with the research of some possible solutions. Moreover, the values of the electrical and magnetic fields for various working conditions, the size of the system, and the energy balance of the reactions are calculated. (auth)

6564 A/CONF.15/P/1460
STUDIES OF HIGH CURRENT GAS DISCHARGES AT HIGH RATES OF BUILD UP. S. C. Curran, K. W. Allen, H. A. B. Bodin, R. A. Fitch, N. J. Peacock, and J. A. Reynolds (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). 27p.

Phenomena associated with high current gas discharges in straight tubes are reported. Condenser banks up to 150 μF and voltages in the range 10 to 30 kv were used in circuits specially devised to give the maximum rate of rise of current. The condensers, which are connected in parallel, are each provided with spark gaps, all of which may be discharged within $\sim 10^{-8}$ sec by means of a special triggering circuit. This parallel connection of condensers and spark gaps results in very low inductance, and rates of rise of current in excess of 10^{12} amp/sec. Neutron emission from discharges in deuterium were observed for currents in the range 10^5 to 10^6 amperes. Data showing the dependence of neutron production on the circuit inductance, voltage, current, and gas pressure are presented. The quenching effect of impurities was investigated, and it was found that neutrons are still observed when as much as 5% of nitrogen is added to the deuterium. In this respect, the results appear to differ from those of other observers who have studied similar discharges. The effect of axial magnetic fields on the discharge characteristics is reported. (auth)

6565 A/CONF.15/P/1471
TRITIUM PRODUCTION AND CYCLING IN A FUSION REACTOR WITH LITHIUM BLANKET. Karl O. Hintermann (Brown Boveri Co. Ltd., Würenlingen, Switzerland and Reactor A. G., Würenlingen, Switzerland) and Rolf Wideröe (Brown Boveri Co. Ltd., Würenlingen, Switzerland). 21p.

The $T(d,n)He^4$ reaction has the advantage of a larger reaction cross section and greater energy release than $D(d,p)T$ and $D(d,n)He^3$ reactions. The neutron slowing down in the lithium blanket is calculated. The spatial distribution of the reaction rates throughout the lithium blanket is treated for slab geometry using Fermi age treatment and the application of the fast neutron diffusion equation. The relationships between the blanket efficiency, the relative $T(d,n)He^4$ reaction rate, and the relative numbers of T and D atoms in the plasma are considered. (W.D.M.)

6566 A/CONF.15/P/1519
THE DESIGN AND PERFORMANCE OF ZETA. E. P. Butt, R. Carruthers, J. T. D. Mitchell, R. S. Pease,

P. C. Thonemann (Atomic Energy Research Establishment, Harwell, Berks, Eng.), M. A. Bird, J. Blears, and E. R. Hartill (Metropolitan Vickers Electrical Co., Ltd., Manchester, Eng.). 57p.

The three main components of ZETA that are described are: the 1,600-μf 25-kv condenser bank; the transformer; and the aluminum torus. The performance of ZETA was studied as a function of condenser voltage, gas type, gas pressure, and the axial magnetic field. Electrical characteristics were measured and analyzed. The hot plasma was studied with sweep pictures, magnetic probes, spectrographic techniques, microwaves, Langmuir probes, and with the x-ray and neutron radiation generated. Typical results obtained are presented. Studies of the spatial, temporal, and energy distribution of the neutrons are reported. (W.D.M.)

6567 A/CONF.15/P/1520

DIAGNOSTIC TECHNIQUES USED IN CONTROLLED THERMONUCLEAR RESEARCH AT HARWELL. G. N. Harding, A. N. Dellis, A. Gibson, B. Jones, D. J. Lees, R. W. P. McWhirter, S. A. Ramsden, and S. Ward (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 35p.

The lines along with diagnostic methods are developing at Harwell are discussed. The results obtained so far are reported. Diagnostic techniques are divided into three groups: spectroscopy, electrical measurements, and the study of high-energy radiations. The first includes the measurement of electromagnetic radiations over a wide range of frequencies, falling into the subdivisions microwave, visible, quartz ultra-violet, vacuum ultra-violet, and x-ray regions. The intermediate regions possess special technical difficulties but are expected to give valuable information when they are investigated. (W.D.M.)

6568 A/CONF.15/P/1708

A LIQUID CONDUCTOR MODEL OF INSTABILITIES IN A PINCHED DISCHARGE. A. Dattner (AB Atomenergi, Stockholm); B. Lehnert (Royal Inst. of Tech., Stockholm); and S. Lundquist (Swedish State Power Board, Stockholm). 7p.

In order to study the instabilities of a pinched gas discharge, a liquid scale model of the discharge column is constructed. The model consists of a freely falling, vertical, cylindrical stream of mercury. The stream is carrying a direct current, and its stability to electromagnetic disturbances is studied. Different types of instability are found in cases with and without a longitudinal magnetic field. A 3000 frames per second high speed camera is used, and the films taken show the growth of "sausage" and lateral instabilities. A possible analogy with gas discharge pinch instabilities is discussed. (auth)

6569 A/CONF.15/P/1941

FUSION CHAIN REACTION WITH CHARGED PARTICLES. M. Gryziński (Univ. of Warsaw). 17p.

It is shown that in an exoergic mixture of high temperature ($\sim 10^7$ °K) or high density ($\sim 10^3$ g/cc) a chain reaction with charged particles can take place. Equations for determining the multiplication factor for a binary mixture under various physical conditions are derived. It is concluded that for an exoergic nuclear mixture there exists a critical temperature or density which limit the slow release of energy. For an infinite medium of 50% DT mixture the critical temperature and density are $\sim 10^7$ °K and $\sim 10^3$ g/cc. (W.D.M.)

6570 A/CONF.15/P/2211

EKSPERIMENTAL'NYE ISSLEDOVANIYA ELEKTRONNOGO REZONANSA I VOLNOVODNYKH SVOISTV PLAZMY. ISSLEDOVANIE PLASMENNYKH SGUSTKOV. (Experimental Research of High Frequency Properties of Plasma and Magnetohydrodynamic Shock Waves.) K. D. Sinel'nikov, P. M. Zeidlits, et al. (U.S.S.R.). 15p.

The research on various types of electron resonance in plasma and preliminary research on ion resonance are described. Plasma density independence upon the magnetic field at a fixed frequency of the generator by means of which the burning of plasma is obtained was determined by a method of high-frequency probes. Intensity of noises was determined near and far from resonance. A problem concerning the penetration of high-frequency fields into plasma wave guides in the magnetic field was investigated. Dispersion dependence was studied. The results obtained are in conformity with theoretical calculations. A problem concerning the plasma clustering and their interaction with inhomogeneous magnetic fields were investigated. A problem concerning the reflection of electromagnetic waves moving in the wave guide from plasma was also investigated. (auth)

6571 A/CONF.15/P/2212

STABILIZATSIYA PLAZMY S POMOSHCH'YU NEODNORODNYKH MAGNITNYKH POLEI. (Plasma Stabilization by Means of Non-uniform Magnetic Fields.) B. B. Kadomtsev and S. I. Braginskii (U.S.S.R.). 14p.

The problem of plasma stabilization by means of non-uniform magnetic fields and guide conductors is considered. It is shown that compensation of the toroidal drift of particles may be obtained by applying periodic variation to the longitudinal field. The stable equilibrium state of plasma in the systems of such type was shown by means of a hydrodynamic consideration. A new method of plasma boundary stabilization, whose pressure is balanced by a magnetic field, was proposed. A variational principle for small oscillations of plasma was obtained, and conditions for its stability were found. Equilibrium stable configurations of plasma in the system with guide conductors were determined. Problems concerning possibility of utilizing these systems for obtaining thermonuclear reactions were discussed. (auth)

6572 A/CONF.15/P/2213

PLASMA RADIATION IN MAGNETIC FIELD. B. A. Trubnikov and V. S. Kudryavtsev (U.S.S.R.). 13p.

A review of some experiments on plasma radiation in a magnetic field is presented. Betatron radiation of a plasma flat layer in the presence of a magnetic field parallel to the layer boundary has been calculated. The degree of plasma radiation confinement necessary for self-sustaining the thermonuclear reaction is reached only if the layer is large. A function of electron distribution in plasma has been calculated for the cases of electrons obtaining energy as the result of collisions with high-temperature ions and radiating it when moving in the magnetic field. The stationary process was investigated, and a function of the distribution of electrons with energy exceeding the mean energy was calculated. Plasma is considered to be fully transparent. A general expression for the dielectric constant of relativistic plasma in a magnetic field was obtained. Absorption coefficients of ordinary and extraordinary waves for high temperatures were determined. (auth)

6573 A/CONF.15/P/2214
DYNAMICS OF RAREFIED PLASMA IN A MAGNETIC FIELD. R. S. Sagdeyev, B. B. Kadomtsev, et al. (U.S.S.R.). 16p.

The results of theoretical investigations of plasma motion in high magnetic fields is presented. The research was carried out with the kinetic equation of self-consistent fields and in hydrodynamic approximation. The relationship between these two lines of approach is discussed. A new kind of plasma instability at temperature anisotropy was found. The existence of such instability results in a disturbance of the homogeneous medium and in some effective energy redistribution of the longitudinal and transverse degrees of freedom associated with coöperative motions. The criterion for such instability at the adiabatic compression of a plasma cylinder with a longitudinal magnetic field was obtained. Approximate motion equations for the case of plasma at a pressure much less than that of the magnetic field were obtained. The problem of plasma equilibrium and stability was considered. Nonlinear effects in the rare plasma dynamics and the influence of collisions are discussed. (auth)

6574 A/CONF.15/P/2215
ABSORPTION OF HIGH-FREQUENCY ELECTROMAGNETIC FIELD ENERGY IN THE HIGH-TEMPERATURE PLASMA. R. Z. Sagdeev (Sagdeyev) and V. D. Shafranov (U.S.S.R.). 19p.

A review is presented of a number of theoretical works in which the possibility of using alternating electromagnetic fields for obtaining controlled thermonuclear reactions is discussed. Equilibrium of a number of the simplest configurations and their stability were investigated using hydrodynamic equations. The single-particle approach was considered on the basis of kinetic equations without collisions, setting limits on the use of hydrodynamics. Considerations are discussed concerning energy values and possible technical difficulties which may occur in an attempt to realize plasma thermal insulation with varying fields. Various methods of plasma heating by means of alternating fields are considered on the basis of an analysis of a given mechanism of electromagnetic oscillation energy and absorption in plasma. Influence of resonance effects upon excitation of oscillations in limited volumes of plasma was studied, as well as possible collisionless dissipation mechanisms. (auth)

6575 A/CONF.15/P/2226
USTOICHIVYI PLAZMENNYI STOLB V PRODOL'NOM MAGNITOM POLE. (Investigation on Plasma Heating in Toroidal Chambers.) I. N. Golovin, D. P. Ivanov, et al. (U.S.S.R.). 26p.

The results of an investigation on processes of plasma formation and heating in toroidal chambers are outlined. The experiments were performed in metallic chambers with an inner diameter of 8 to 50 cm; the toroid diameters were 50 to 125 cm. The experiments were carried out with constant and alternating outer magnetic fields. The installations give the possibility of varying the magnetic field intensity. Discharges were performed in deuterium and other gases at pressures of 10^{-4} to 10^{-2} mm Hg. The maximum current in the discharge exceeds 400 ka. The period of current growth as well as that of the applied external magnetic field was varied in a wide range. The investigation of the processes occurring in the plasma was carried out by means of magnetic and electric probes, photographic and spectrographic techniques, registration of penetrating radiation, and some other methods. (auth)

6576 A/CONF.15/P/2228
SPECTROSCOPIC RESEARCH OF HIGH-TEMPERATURE PLASMA. S. Yu. Lukyanov and V. I. Sinitsin (U.S.S.R.). 22p.

Descriptions are given of some of the spectroscopic methods applicable to studies of pulse discharge plasma kinetics. Unique conditions met in plasma research are briefly discussed, and spectroscopic methods used in the determination of specific parameters are reviewed. Among the parameters discussed are electron temperature, energy distribution, charged-particle density, ion temperature, and spectral line broadening. (D.E.B.)

6577 A/CONF.15/P/2298
ISSLEDOVANIYA PO UPRAVLYAEMYM TERMOYADERNYM REAKTSIYAM V SSSR. (Investigations on the Controlled Thermonuclear Reactions in the U.S.S.R.) L. A. Artsimovich (U.S.S.R.). 72p.

Research in the U.S.S.R. on the problems of controlled thermonuclear reactions is concentrated on the development of methods of heating matter to very high temperatures in powerful pulsed electromagnetic processes of short duration, investigations of plasma heating methods in quasi-stationary high current electric discharges, and investigations of plasma heating and containment in systems of a "magnetic trap" type. The principal data obtained in experimental and theoretical investigations in these directions are analyzed. The general criteria used in evaluating different systems which may, in principle, be used for the production of thermonuclear energy are presented. Different types of magnetic traps in which the function of containment is controlled by external magnetic fields are discussed. The different methods used for obtaining matter heated to a very high temperature in these systems are presented. (J.S.R.)

6578 A/CONF.15/P/2300
K TEORII VYSOKOCHASTOTNYKH KOLEBANII PLAZMY. (Theoretical Research on High-Frequency Properties of Plasma and Magnetohydrodynamic Shock Waves.) A. I. Akhiezer, Ya. Fainberg, A. Sitenko, et al. (U.S.S.R.). 27p.

Problem concerning resonance in confined plasma in cases when the projection of the wave vector in the direction of the magnetic field is other than zero or equals zero was investigated. Movement of electrons and ions, as well as collisions between them, were taken into account. It was shown that at high plasma density and high temperatures the cyclotron frequency resonance takes place according to the geometrical mean value of cyclotron frequencies of electrons and ions. The law of penetration of electromagnetic fields into plasma and dispersion relation in case of resonance were determined and other parameters of the system were calculated. Magnetohydrodynamic shock waves were considered. Mechanical and thermodynamic conditions are discussed. Jumps of magnetic field at discontinuities and simple waves in magnetohydrodynamics were also studied. Problems concerning the excitation of hydromagnetic and magnetoacoustic waves by means of external currents were also considered. Radiation intensity, with permeability and viscosity of medium being taken into account, was determined. Comparison with other methods of excitation was made, and the kinetic theory of magnetohydrodynamic waves in plasma was developed. (tr-auth)

6579 A/CONF.15/P/2301
AN EXPERIMENTAL STUDY OF HIGH-CURRENT PULSE DISCHARGES. A. M. Andrianov, O. A. Bazilevskaja, S. I. Braginskii (Braginsky), et al. (U.S.S.R.). 50p.

Straight discharge tubes with both porcelain and metal walls were used in experiments with pulse discharges in gases. The discharge was produced in hydrogen, deuterium, and some other gases in a wide range of pressures. Data on the distribution of electric and magnetic fields were obtained. The data so obtained give an estimate of kinetic temperatures. Measurement of pressure pulses made possible an estimation of the pinch density in the contraction stage. New results were obtained on the spatial distribution and energy spectrum of neutrons in chambers with metal walls. The maximum energy of the x rays from the gas discharge was measured by a cloud chamber method. The energy of fast deuterons arising in the pulse discharge was measured. (auth)

6580 A/CONF.15/P/2302
PLASMA MOTION OF POWERFUL DISCHARGES IN THE CURRENT'S PROPER MAGNETIC FIELD. V. S. Komelkov (U.S.S.R.) 18p.

Results of research in the plasma motion of powerful impulse discharges conducted with the aid of photoscannings, Kerr cell photographs, and time magnifiers are described. Oscillograms were taken between voltage electrodes and of discharge current. Plasma contraction in three axes and flushing out of the gas from the center to the periphery of the chamber were studied. In some discharges a relatively higher current cord stability than in the ordinary cylindrical constriction is observed. (W.D.M.)

6581 A/CONF.15/P/2500
TO THE THEORY OF HIGH-TEMPERATURE PLASMA PINCH. S. I. Braginskii (Braginsky) and V. D. Shafranov (U.S.S.R.). 43p.

Some systems with plasma pinch stabilization by a longitudinal magnetic field are examined from the standpoint of the possibility of heating the plasma and obtaining thermonuclear reactions. It is assumed that the plasma pinch is toroidal so that there are no losses at electrodes which exist in straight tube discharges. In cases considered the plasma is heated due to the Joule heat and compression of the plasma caused by the constricting currents. (W.D.M.)

6582 A/CONF.15/P/2501
THERMAL INSULATION AND CONFINEMENT OF PLASMA WITH A HIGH-FREQUENCY ELECTROMAGNETIC FIELD. A. A. Vedenov, T. F. Volkov, et al. (U.S.S.R.). 18p.

Preliminary results are outlined of experiments conducted to check the conclusions of the theory of the possible confinement of plasma by means of alternating electromagnetic fields. Fields excited in volume resonators were used in the experiments. Plasma was produced in a longitudinal magnetic field inside a straight quartz tube, rectangular volume resonators being placed along its butt ends. The ends of the tube were set into the resonators 15 mm deep through openings. (W.D.M.)

6583 A/CONF.15/P/2506
A SURVEY OF THE ENERGY BALANCE IN A THERMONUCLEAR REACTING PLASMA, CONTAINING DEUTERIUM, TRITIUM AND REACTION PRODUCTS UNDER ISOTHERMAL PULSED OR STEADY-STATE CONDITIONS. T. Hesselberg Jensen, O. Kofoed-Hansen, and C. F. Wandel (Danish Atomic Energy Commission Research Lab., Risø). 25p.

The energy balance in a thermonuclear reacting plasma containing deuterium, tritium, and their charged reaction products is investigated. Energy is thought to be transferred to the surroundings by electromagnetic radiation, kinetic energy of neutrons, and heat content of extracted gas. In general, a definite fraction, ϵ, of this energy has to be reinjected in order to keep the plasma isothermal. The behavior of ϵ is investigated for two types of isothermal systems, a steady-state system with continuous fuel injection and plasma extraction, and a non-steady system without injection or extraction of particles. Three relevant parameters are found, the temperature, the tritium enrichment, and the deuterium burn-up. By varying these parameters optimum values of each are found for the steady-state. The non-steady system is shown to have very similar properties. The effects of the finite energy transmission rates between the charged particles in the plasma are investigated in the steady-state case. (auth)

CRITICALITY STUDIES

6584 A/CONF.15/P/36
APPLICATION OF VARIATIONAL PRINCIPLES TO THE CALCULATION OF CRITICAL SIZES. R. T. Ackroyd (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). 55p.

Variational principles are given for one- and two-group diffusion theory for bare and reflected reactors. A variational principle is also given for the albedo method of calculating critical sizes of small fast systems with moderating reflectors. These principles can be used directly to give reasonably close upper and lower bounds for critical size, or they can be used with either the Rayleigh-Ritz procedure or the methods of optimized parameters and optimized coefficients to obtain more accurate upper bounds. (auth)

6585 A/CONF.15/P/40
CRITICAL AND SUB-CRITICAL EXPERIMENTS WITH A TWO-GROUP CORRELATION OF RESULTS. C. G. Campbell and I. S. Grant (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 57p.

The two-group neutron diffusion equations are developed with one equation referring strictly to thermal neutron events only, and the other to epithermal events. Particular attention is paid to averaging the diffusion parameters correctly over the appropriate region of the neutron velocity spectrum adopted. The effects of epithermal neutron absorption upon the slowing down area are taken into account. The experimental information necessary to elucidate the neutron fates within this theoretical framework is discussed, together with ways in which this may be restricted for more complex fuel shapes, in the light of information obtained from experiments with simple fuel arrangements. The experimental difficulties are discussed and the techniques adopted are outlined. The correlation of these results is described, and the method is applied to the cases of hydrogenous and graphite moderated assemblies. Problems associated with the physics of systems with a relatively small number of fuel elements for criticality are discussed. (auth)

6586 A/CONF.15/P/88
CRITICAL ASSEMBLY EXPERIMENTS AT DOUNREAY.

G. W. K. Ford and J. G. Walford (United Kingdom Atomic Energy Authority, [Caithness, Scotland]). 23p.

A laboratory was constructed at the Dounreay U.K.A.E.A. research station for critical assembly experiments upon a wide variety of systems. The immediate object was the investigation of certain safety problems associated with the Authority's fissile material processing factories. Three different types of critical experiments are described which were carried out in order to assist with the safety problems which arise in fissile material processing plants handling aqueous and organic solutions of highly enriched U. (W.D.M.)

6587 A/CONF.15/P/160
EXPONENTIAL EXPERIMENTS ON HEAVY WATER–NATURAL URANIUM METAL AND OXIDE LATTICES. R. Persson, E. Blomsjö, J. Döderlein, E. Andersen, and O. Aspelund (AB Atomenergi, Stockholm). 23p.

A description is given of some unique features of the experimental facility. The theory of mixed lattices is discussed. Measurements are reported on the buckling for lattices consisting of clusters of uranium metal and oxide rods in D_2O at room temperature, the temperature coefficient between 10 and 80°C for D_2O and for different lattices, and control rod effects. (W.D.M.)

6588 A/CONF.15/P/570
THE INFLUENCE OF GAPS ON THE NEUTRON FLUX DISTRIBUTION AROUND CYLINDRICAL ABSORBING RODS IN DIFFUSING MEDIA. Jan M. Døderlein (Joint Establishment for Nuclear Energy Research, Kjeller, Norway). 24p.

The flux distribution around cylindrical absorbing rods (cadmium and uranium) has been measured, both with and without an air-gap surrounding the rod, and for different axial and radial air-gap dimensions. The experimental results are compared with flux distributions calculated by diffusion theory and by spherical harmonics expansions. The flux distributions calculated by diffusion theory are strongly dependent on the extrapolation length assumed. Without air-gap, good fit to the experimental results is obtained with diffusion theory. With air-gap, it does not seem possible to fit the over-all flux distribution with diffusion theory. In the air-gap, however, diffusion theory fits the experimental results within the limits of error. The ratio between the fluxes incident on the rod, with and without air-gap, is substantially higher than what is expected by taking into account only the neutron absorption of the water removed. (auth)

6589 A/CONF.15/P/575
EXPONENTIAL EXPERIMENTS WITH URANIUM OXIDE CLUSTERS IN HEAVY WATER. E. Andersen and O. Aspelund (Joint Establishment for Nuclear Energy Research, Kjeller, Norway). 7p.

Measurements of the buckling of natural uranium oxide clusters in heavy water are presented. The clusters contain 6 and 7 oxide rods canned in aluminum. (A.C.)

6590 A/CONF.15/P/1192
CRITICAL AND SUBCRITICAL EXPERIMENTS ON U-BeO LATTICES. P. Benoist, Ch. Gourdon, J. Martelly, M. Sagot, and G. Wanner (Commissariat à l'Énergie Atomique, Paris); and V. Deniz, B. V. Joshi, and K. Sahai (Atomic Energy Establishment, Trombay, India). 60p.

The material buckling of natural uranium–beryllium oxide lattices was measured. The square cell or element had a pitch of 15 cm and uranium rods of 2.60, 2.92, 3.56, and 4.40 cm. A critical experiment was conducted with hollow uranium rods enriched to 1.35%. (W.D.M.)

6591 A/CONF.15/P/1193
UNE METHODE D'EXPERIMENTATION SOUS CRITIQUE "LE NEUTROSTAT." (A Sub-Critical Experimental Method: The Neutrostat.) J. Martelly (Commissariat à l'Énergie Atomique, Paris). 23p.

A sub-critical experimental method is described in which the medium being investigated is surface irradiated by a neutron source of uniform density. The surface of the medium is spherical for small samples and cylindrical for large samples. The neutron density in the medium is uniform if the medium is a perfect diffuser. Any curve in the distribution would be a sensitive indication of the multiplying or absorptive properties of the medium. The methods of irradiation are discussed, and the method is applied to the measurement of the laplacian of a sub-critical lattice. Correction terms are discussed. Advantages of this method over those of the exponential experiments are the avoidance of the anisotropy and uncertainty over the extrapolation length as the flux distribution is the same as in the axial region of a critical cylindrical lattice. The principle of the method is illustrated by measurements made on the laplacian of natural U–BeO lattices. The application of this method to the study of non-multiplying media is discussed. (J.S.R.)

GEOLOGY AND MINERALOGY

6592 A/CONF.15/P/42
A SYSTEM OF ORE MINERAL IDENTIFICATION. S. H. U. Bowie and K. Taylor (Geological Survey, London). 33p.

The microscopic determination of ore minerals presents many more problems than are associated with the recognition of transparent species. It is shown that accurate measurements of reflectivity and indentation hardness are sufficiently reproducible to form the basis of a systematic scheme of identification that is easy to apply and is more reliable than any other at present. The reflectivity and hardness measurements are made on the same mineral grain and each takes less than one minute. Subsidiary properties used in the system include color, anisotropism, pleochroism, and dispersion of the reflectivity. All ore samples examined so far can be identified without use of chemical methods. (auth)

6593 A/CONF.15/P/43
AIRBORNE RADIOMETRIC SURVEY OF CORNWALL. S. H. U. Bowie and J. M. Miller (Geological Survey, London) and J. Pickup and D. Williams (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 27p.

The possibility of locating radioactive ores by gamma-ray measurements in aircraft was first studied in Great Britain in 1946, but at this time no instrument of the required sensitivity was available. Since then the development of thallium-activated sodium iodide scintillation counters and of transistor circuits and recorders has made it possible to design instruments which have the necessary sensitivity and are suitable for use even in light aircraft. The survey method adopted was based on North-South flight lines flown parallel to the National Grid at intervals of 0.4 km.

Each flight line commenced and finished over the sea where background level checks could be made. A constant ground clearance of 500 feet was aimed at, though, because of local topography, limits of ±100 feet were allowed in the flight specification. Results obtained on single-crystal and three-crystal scintillation counters are compared and airborne anomalies are correlated with subsequent ground observations. The use of airborne scintillation counters for primary reconnaissance surveys and as a tool in secondary prospecting is discussed and practical examples given. (auth)

6594 A/CONF.15/P/106
APPLICATION OF X-RAYS TO THE INVESTIGATION OF RADIOACTIVE MINERALIZATIONS. L. Van Wambeke (Centre D'Étude de L'Énergie Nucléaire, Brussels). 16p.

A quick and accurate method for surveying radioactive minerals and mineralizations is presented. The major or accessory chemical components can readily be determined from their x-ray spectra, and semi-quantitative evaluations can be made by means of suitable counters. Structural analysis is carried out preferably by means of a spectrometer. The Guinier curved crystal technique was used for finer determinations of the structures. (auth)

6595 A/CONF.15/P/178
URANIUM MINERALISATION IN IRON ORES OF CENTRAL SWEDEN. Carl Mårtensson and Eric Welin (AB Atomenergi, Stockholm). 7p.

The Archean bedrock of Central Sweden consists of highly metamorphic leptites, greenstones, and sedimentary rocks penetrated by various granites and pegmatites. Parts of this area are rich in different ores among which the iron ores are the most important. Skarn-type ores are common, and in some of them uranium minerals have been found. The investigation of this uranium mineralization is still going on. Till now it has been shown that the uranium, in the form of primary and secondary minerals, is concentrated in tectonized zones of the skarn rocks. The iron ore (usually magnetite) and penetrating pegmatites are not uranium bearing. (auth)

6596 A/CONF.15/P/221
TYPES AND ORE RESERVES OF CANADIAN RADIOACTIVE DEPOSITS. J. W. Grittith, A. H. Lang, et al. (Geological Survey of Canada, Ottawa). 10p. (AECL-631). $0.25(AECL).

Figures for production of uranium in Canada and for reserves of radioactive ores are summarized. A revised classification and a short discussion of geological types of productive and nonproductive radioactive deposits are presented. Low-grade thorium deposits are known to occur in large tonnages, particularly at Blind River. The ores of this region as a whole, although not sampled for thorium as exhaustively as for uranium, are estimated to average about 0.05% ThO_2; some very large deposits average about 0.1% ThO_2, and certain ores carry 0.2 to 0.3% ThO_2. The ores now being mined for uranium at Bancroft are reported to carry about 0.02 to 0.2% ThO_2, and material with still higher content is said to be available. (auth)

6597 A/CONF.15/P/222
ON THE GEOLOGY AND RADIOACTIVE DEPOSITS OF BLIND RIVER REGION. S. M. Roscoe and H. R. Steacy (Geological Survey of Canada, Ottawa). 19p. (AECL-632). $0.25(AECL).

The uranium deposits near Blind River, Ontario, are in beds of pyritic quartz-pebble conglomerate near the base of a sequence of Precambrian sedimentary rocks called Huronian; these unconformably overlie granitic rocks, gneisses, and greenstone. The basal Huronian formation, evidently derived from an extensive pre-Huronian surface covered with residual detritus, consists of grit, pebbly arkose, feldspathic quartzite, and quartz-pebble conglomerate. The lithology varies greatly from place to place. Primary sedimentary structures indicate that the formation was deposited and sorted by streams that flowed from northwest to southeast. The formation shows pronounced local variations in thickness aligned to the southeast. The thicker parts apparently overlie valleys on the pre-Huronian surface. Most of the uranium ore lies within two such valley-like structures whose central parts contain the most numerous, closest spaced, thickest, and most radioactive conglomerate beds. Data on the uranium–thorium content of different rock types are presented. Ratios of thorium to uranium in most quartzites and conglomerates are similar to ratios in older granitic rocks to the northwest. The lowest ratios of thorium to uranium (as low as 0.1) are found in ore conglomerates along central parts of the ore zones and represent a high proportion of uranium-rich minerals (uraninite and brannerite) to thorium-bearing minerals (chiefly monazite). In ore zones, ratios commonly show wide differences in individual lenses. There is, however, a general increase of ratios in successively higher conglomerate beds upward through the basal formation. Ratios also increase laterally toward and beyond the boundaries of ore zones. These and other data when carefully studied in relationship to the very complex stratigraphy of the basal formation may show systematic variations in the mineralogy of the radioactive conglomerates which can be related to variations in the velocities of paleocurrents. (auth)

6598 A/CONF.15/P/223
GEOLOGY AND URANIUM DEPOSITS OF BEAVERLODGE REGION, SASKATCHEWAN. L. P. Tremblay (Geological Survey of Canada, Ottawa). 16p. (AECL-633). $0.25(AECL).

The Beaverlodge area is within, and near the western border of, the Canadian Shield. It is dissected into ridges trending northeasterly. Relief is generally less than 100 m. The oldest rocks, possibly Archaean, are called the Tazin group. They were once sediments, but now they are mainly rocks granitized to banded gneisses and granites. Locally, they are quartzite, dolomite, argillite, quartz-biotite schist, garnetiferous gneiss, amphibolite, and chlorite-epidote rocks. Folds in the Tazin rocks are open, tight, isoclinal, and locally complex. Uranium deposits are pegmatitic and hydrothermal. Pegmatitic deposits are in Tazin rocks only, but none has proved economic. Hydrothermal deposits occur in both the Tazin and Athabasca rocks, but almost all production is from ore bodies in the Tazin. They are of the disseminated type and the vein type. The probable formation of the deposits is given. The most favorable rocks affecting deposition of pitchblende appear to have been siliceous argillite or related mixtures. The geology and structure of the main mining properties are described specifically. (auth)

6599 A/CONF.15/P/224
URANIUM DEPOSITS OF BANCROFT REGION, ONTARIO. S. C. Robinson (Geological Survey of Canada) and D. F. Hewitt (Ontario Dept. of Mines, Can.). 8p. (AECL-634). $0.25(AECL).

Uranium deposits of the Bancroft region of southeastern Ontario include pegmatitic granite dykes, pegmatites, metasomatic deposits, and calcite-fluorite-apatite veins. Only deposits belonging to the pegmatitic granite class have thus far been worked commercially. These are the only deposits of the general pegmatitic class from which uranium is being produced in Canada. Two mines with plants of 900 ton (1,000 short tons) of ore a day are producing and a third is scheduled to begin production in 1958. Another mine is shipping ore. Most of the deposits occur in Faraday, Cardiff, and Monmouth townships in an area extending 40 km in a southwesterly direction between Bancroft and Tory Hill. This region contains three major batholiths which are mantled by variably granitized paragneiss and lime-rich metamorphic rocks. A few of the uranium deposits occur within the batholithic complexes and a few others are remote from them but most, including all the major deposits, lie in the rocks mantling the batholiths. Principal radioactive minerals in the deposits are uraninite and urano-thorite. In the granitic deposits, zircon is abundant and its distribution is similar to that of uranium minerals. Virtually all deposits contain calcite and fluorite in minor but significant amounts. The ore bodies are fairly large and have average uranium contents greater than has usually been demonstrated for pegmatitic deposits. The grades are of the order of 0.1% U_3O_8 and from 0.025 to 0.2% ThO_2. Recent studies have indicated that the most favorable factors are probably structural position and competency and chemical composition of wall-rocks. (auth)

6600 A/CONF.15/P/225
THE RADIOACTIVE PEGMATITES OF SASKATCHEWAN. J. B. Mawdsley (Univ. of Saskatchewan, Saskatoon, Can.). 16p. (AECL-635). $0.25(AECL).

A few typical occurrences of the radioactive pegmatite and migmatite bodies so far found are described. These can readily be considered as falling into two dissimilar groups, coarse-grained radioactive pegmatites, which are usually in the form of sills, and fine-grained radioactive pegmatites and related migmatites. Reasons are suggested why these bodies are radioactive while other neighboring ones are not. Tests have been carried out on material from a few of these radioactive bodies which indicate that the extraction of the uranium content is relatively simple and not unduly expensive. (auth)

6601 A/CONF.15/P/226
MINING METHODS AND PRODUCTION COSTS AT MAJOR CANADIAN URANIUM MINES. R. E. Barrett (Eldorado Mining and Refining Ltd., Ottawa) and R. R. Bassermann (Gunnar Mines Ltd., Uranium City, Saskatchewan, Can.), et al. 26p. (AECL-636). $0.25 (AECL).

The techniques and economics of mining Canadian uranium ores as exemplified by the major mines are described. (auth)

6602 A/CONF.15/P/250
DETERMINATION OF EXTREME Th/U-RATIOS IN MINERALS. A RADIOCHEMICAL METHOD FOR DETERMINATION OF THORIUM. H. R. von Gunten, W. Buser, and F. G. Houtermans (Univ. of Bern). 9p.

For age determination of U and Th minerals an accurate measurement of the Th/U ratio is needed, especially when accessory lead is present. The correction of accessory lead may be made on the basis of the isotope Pb^{208}. It is therefore necessary to determine very low contents of Th in U minerals very exactly to have a measure for radiogenic Pb^{208}. The quantitative determination of thorium in minerals by chemical methods is rather laborious. The proposed radiochemical method reduces the chemical separations to a minimum. The principle of the method consists of an analysis of the decay curve of the lead fraction. After dissolution of the mineral all lead is extracted by the dithizone method. The extracted lead is measured in liquid counter tubes. After decay of short-lived RaB, AcB, and daughter products the radioactivity increases, until equilibrium of ThC and ThB is attained. Then the radioactivity is determined during 3 to 48 hours by ThB + C + C". In case of very low Th/U ratios ($<10^{-3}$) the solution was extracted twice with inactive lead as carrier. The second extraction of the same solution, after growth of ThB, allows an accurate measurement of ThB and therefore of the Th content in the solution. The disturbing effect of RaE is in this way reduced by the ratio of 0.5 days to 30 years. Th can be determined down to a ratio Th/U $\sim 10^{-4}$. The method is also practicable for high Th/U ratios. It is evident that the method is restricted to Th and U minerals in complete radioactive equilibrium. (auth)

6603 A/CONF.15/P/282
SOME GEOCHEMICAL DETERMINATIONS USING RADIOACTIVE AND STABLE ISOTOPES. A. A. Smales, D. Mapper, J. W. Morgan, R. K. Webster, and A. J. Wood (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 15p.

The application of neutron activation and mass spectrometer-isotope dilution methods to geochemical analyses is discussed. The determination of elemental abundances in meteorites and of geological age of minerals is described. Cu, Cr, Ge, As, and Sb were determined in iron meteorites by the neutron activation method. Accurate and precise methods were developed for these trace elements, using a composite radiochemical separation scheme on irradiated single samples of about 200 mg. The division of iron meteorites into "quantized groups" is confirmed. The germanium contents found were higher than those found for the same meteorites by previous investigators. Cesium in stony meteorites was determined by a mass spectrographic isotopic dilution method. The cesium contents were distributed over a range from 0.01 to 0.3 ppm with a mean value of about 0.1 ppm. Rubidium–strontium ages were found by stable isotope dilution analysis for several feldspars from regions of known geological age. With one exception, there was close agreement between the age found and the apparent age. (J.S.R.)

6604 A/CONF.15/P/299
RECENT DEVELOPMENTS IN INSTRUMENTATION FOR THE SURVEY, ASSAY AND MINING OF RADIOACTIVE RAW MATERIALS. H. Bisby, D. Williams, and F. H. Hale (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 32p.

The development of portable instruments for geological surveying is discussed. Detailed descriptions are given of the light-weight Geiger counter designed for use by prospectors, the more comprehensive Geiger counter ratemeter with which the geologist can carry out preliminary survey and assay work in the field, and the scintillation counter which is used in areas showing small anomalous radioactivity. The last two instruments were designed to be also main components of equipment used for other applications. The Geiger

counter is used in a portable borehole/well-logging equipment, a less portable borehole/logging equipment fitted with Geiger or scintillation probes, an ore selection equipment for stope control work, and a tub ore-grade selector. The scintillation counter, combined with a light-weight spark recorder, comprises a relatively inexpensive and versatile car survey or air reconnaissance equipment. Two operational aerial survey instruments are described in some detail. The results of an investigation into the possibility of discriminating against thorium or potassium in favor of uranium in an airborne gamma spectrometer are reported. The standardization of instruments of field operations is described. (J.S.R.)

6605 A/CONF.15/P/322
ADAPTATION DE LA CHROMATOGRAPHIE SUR PAPIER A LA PROSPECTION GEOCHIMIQUE DES GITES D'URANIUM DE TYPE KATANGAIS. (The Adaptation of Paper Chromatography to the Geochemical Prospection of Uranium Deposits of the Katanga Type). Jacques Jedwab (Univ. of Brussels). 9p.

In the geochemical prospecting of uranium deposits of the Katanga type, which contain many metals, it is often necessary to make a determination of traces of copper, cobalt, and nickel in the soil, in addition to that of uranium. A modification of a paper chromatographic technique is described which permits a simple, economical, and rapid determination of these elements. The soil sample is digested with dilute nitric acid and an aliquot is used for the U determination. Hydrochloric acid is added to the remaining solution and the determination is made for Cu, Co, and Ni. With this method one hundred determinations of soil samples can be made each day. (J.S.R.)

6606 A/CONF.15/P/1107
THORIUM- AND RARE-EARTH-BEARING MINERALS IN THE UNION OF SOUTH AFRICA. D. R. Pike (Atomic Energy Board, Pretoria). 15p.

A variety of thorium- and rare-earth-bearing minerals occurs in South Africa, but most of the deposits are too small to assume economic significance. At present the only mineral which is being produced primarily for rare earths and thorium is monazite from a lode deposit in the western Cape Province. Pegmatite resources are largely untapped. Much of the base mineral content has already been disposed of, but up to the present there has been no demand for the radioactive or rare-earth-bearing minerals. Apart from the minerals available from this source, bastnaesite, calcium-yttrium silicate, allanite, and uranothorianite could be profitably produced from the Union should the demand for thorium and rare earths improve. (auth)

6607 A/CONF.15/P/1108
SOME REACTOR MATERIALS OTHER THAN FUELS IN THE UNION OF SOUTH AFRICA. John de Villiers (Geological Survey of the Union of South Africa). 8p.

The current production and reserves of beryllium, vanadium, and zirconium in the Union of South Africa are presented. (W.L.H.)

6608 A/CONF.15/P/1110
THE INTERPRETATION OF AGE MEASUREMENTS ON THE WITWATERSRAND URANINITE. J. W. L. de Villiers, A. J. Burger (National Physical Research Lab., C.S.I.R., Pretoria); and L. O. Nicolaysen (Univ. of the Witwatersrand, Johannesburg). 5p.

The isotopic ages of certain uraninite concentrates from the Witwatersrand System have been used by other workers as evidence supporting a detrital origin of the uraninite. This argument is critically examined, in the light of new isotopic measurements. There is strong evidence that the minute uraninite grains have suffered extensive loss of radiogenic lead, after their incorporation in the Witwatersrand System. It is concluded that, at the present time, age measurements on the Witwatersrand uraninites do not have a critical bearing on their detrital or epigenetic origin. More accurate data are required concerning the age of initial crystallization of the uraninite and the age of deposition of this system. (auth)

6609 A/CONF.15/P/1111
THE MODE OF OCCURRENCE AND THEORY OF ORIGIN OF THE URANIUM MINERALS AND GOLD IN THE WITWATERSRAND ORES. W. R. Liebenberg (Government Metallurgical Lab., Johannesburg). 23p.

The gold–uranium ores of the Witwatersrand goldfields consist mainly of compact metamorphosed conglomerates occurring as bands in a thick body of sediments spread laterally over a vast area. These sediments consist predominantly of quartzites. The conglomerate consists mainly of pebbles of vein-quartz cemented by a fine-grained matrix composed principally of quartz and phyllosilicates. The valuable constituents are almost entirely confined to the matrix of the conglomerate, the pebbles of quartz being virtually barren. Some uranium and gold are present in banded pyritic quartzites occupying erosion channels cutting the bands of conglomerate. (auth)

6610 A/CONF.15/P/1123
AN IMPROVEMENT OF THE AGE-DETERMINATION BY THE ^{14}C METHOD. A. E. de Vries and A. Haring (Foundation for Fundamental Research on Matter, Amsterdam). 4p.

The age determination of samples containing C^{14} has been improved by increasing the specific activity in a known way in a thermal diffusion column. The sample is converted to CO prior to enrichment, and a suitable quantity of gas is withdrawn from the bottom of the column when the C^{14} and the O^{18} concentrations have been increased sufficiently. From the O^{18} abundance the enrichment of the C^{14} which is not the same, is obtained. Samples have been enriched by a factor of 12 in the C^{14} concentration which means a gain of about 20,000 years in the age determination. (auth)

6611 A/CONF.15/P/1240
THE PRESENT STATE OF URANIUM AND THORIUM PROSPECTION IN THE FRENCH UNION. A. Lenoble and A. Gangloff (Commissariat à l'Énergie Atomique, Paris). 19p.

A general outline of uranium prospecting in France at present is given. The major part of the reserves insuring present and future production for the next few years is to be found in the hercynian crystalline zones of the Forez, the Limousin, and Vendée. They are the Bois-Noirs, Brugeaud, Fanay-les-Sagnes, Margnac, la Chapelle Largeau, l'Ecarpière, and la Commanderie fields. Their general characteristics are given, together with the scale of their proved extension, determined either by mining works or by drilling. In each of these districts, moreover, numerous occurrences have been located, some of which are now being mined. Apart from these three massifs, other hercynian zones, either in the Massif Central or in Brittany, are liable to contribute greatly to uranium supplies in the near future. During the last few years, various private firms

have undertaken mining surveys. The C.E.A. has completed the survey of the uranium shale field in the Vosges. (auth)

6612 A/CONF.15/P/1241
GEOLOGIE DES GITES URANIFERES ET FILONIENS EN FRANCE. (Geology of Uranium Vein Deposits in France.) Jean A. Sarcia, Henri Carrat, Andrê Poughon, and Henri Sanselme (Commissariat à l'Énergie Atomique, Paris). 52p.

The four vein deposits of France, discovered and developed since 1946, are those of Forez in the Massif Central, those of Morvan and North Limousin in the eastern and western parts, and those of the Massif de Vendée. All these mineralized districts occur in granite bodies, more or less enriched with muscovite. All the veins are located inside granite, except in Vendée where some also occur in metamorphic country rocks. The geology and mineralization of each are discussed in detail. (J.S.R.)

6613 A/CONF.15/P/1242
THE URANIUM-BEARING SHALE DEPOSITS AT ST. HIPPOLYTE (HT. RHIN). AN EXAMPLE OF A STUDY BY STATISTICAL CALCULATION. A. Carlier (Commissariat a l'Energie Atomique, Paris). 19p.

The uranium bearing shale ore-body at St. Hippolyte was mainly proved by drillings, the results of which were studied through statistical methods. An account is given of conclusions regarding the distribution of mineralization, its origin and the estimate of reserves. The uranium mineralization is irregularly distributed in shales. On a vertical line, levels could be singled out. They are similar, as far as lithology is concerned, but each of them is characterized by a grade-population, according to a lognormal distribution. Horizontally, a connection is noted between grades and the overlying barren sandstone bed. These considerations, as well as a statistical study of U/Ra ratio, induced the consideration that the mineralization of the richest level has an hydrothermal origin. It is only through a uranium diffusion from that level that the others are mineralized. The uranium which is contained in poorest beds has a syngenetic origin. Furthermore, statistical methods are used for an evaluation of reserves. In such a case, the evaluation is equivalent to the ore obtained by common arithmetical methods. One can state precisely the upper and lower limits where a true tonnage or a true grade could be given with a definite value of statistical certainty. The separation of reserves in grade-groups was studied, and the effect of sorting in connection with the lower possible grade and with extraction units (wagons, lorries, etc.), on which the sorting will be done was predicted. The value of both classical and statistical methods are indicated. These two techniques complement each other as they solve different problems. (auth)

6614 A/CONF.15/P/1243
LA PROVINCE URANIFERE DU NORD-LIMOUSIN—SES TROIS PRINCIPAUX GISEMENTS. (Uranium District of Northern Limousin—Its Three Main Deposits.) Jean A. Sarcia (Commissariat a l'Energie Atomique, Paris). 34p.

The three main uranium deposits being developed in northern Limousin are Les Sagnes, Margnac, and Le Brugeaud. The structure and mineralizations are described in detail. The history of each mine and the methods used in studying it are discussed. All mines are predominantly pitchblendes. In Les Sagnes the concentrations are in relation to lamprophyric loads. The concentrations in Margnac occur in syenitic differentiations included in the muscovite-granite country rock. In Le Brugeaud the concentrations are related to endomorphic differentiations in the granite boundaries. (J.S.R.)

6615 A/CONF.15/P/1244
APPLICATION OF THE GEOPHYSICAL AND GEOCHEMICAL METHODS TO THE SEARCH FOR URANIUM. A. M. Gangloff, C. R. Collin, A. Grimbert, and H. Sanselme (Commissariat à l'Énergie Atomique, Paris). 20p.

Several geophysical methods of uranium prospecting (such as seismic refraction, magnetic methods, and electrical logging) are briefly described, but the electrical methods using direct current are discussed in detail because of their wide applicability and low cost. Geochemical methods are used to make precise the knowledge of the distribution of uranium traces in soils. The study of radon emanations has given valuable information. The combined use of these methods is described. Methods of preliminary surveying of large regions are discussed. (J.S.R.)

6616 A/CONF.15/P/1245
LA PROSPECTION DES MINERAIS D'URANIUM ET DE THORIUM DANS LES PAYS DESERTIQUES ET DANS LES REGIONS DE FORÊT ÉQUATORIALE DE L'UNION FRANÇAISE. (Methods Applied to Uranium and Thorium Ore Prospecting. a. In the Desert Countries. b. In the Equatorial Forest Regions of the Union Française). Jean J. Lecoq, Georges Bigotte, Jean Hinault, and Jean R. LeConte (Commissariat à l'Énergie Atomique, Paris). 90p.

Since 1946 the Commissariat a l'Energie Atomique has supported explorations for uranium and thorium deposits in the French territorial possessions of French territorial possessions of French Africa, Madagascar, and French Guiana. A large part of this territory is desert, equatorial forest, or savannah regions. The particular difficulties of prospecting for radioactive minerals in these territories include the geographic character of the region, the climate, and the lack of access and skilled labor. The different methods of prospecting in the desert and equatorial forests include photogeology, aerial and ground prospecting, geochemical and geophysical techniques, and the training of local labor for prospecting. These techniques are described, and the results obtained are discussed. Three examples of prospecting in countries with extreme climates are given. (J.S.R.)

6617 A/CONF.15/P/1246
APPLICATION DES METHODES MATHEMATIQUES A L'ETUDE DES GISEMENTS D'URANIUM. (Mathematical Methods Applied to the Survey of Uranium Deposits). Philippe Formery and Valéry Ziegler (Commissariat à l'Énergie Atomique, Paris). 18p.

The application of statistical methods to a survey of uranium deposits in France was studied. The gamma emission of uranium and its connection with grade was used as the standard in the survey from the first explorations to chemical processing. The correlation between radioactivity and uranium content was studied and it was shown that it is expressed, in bilogarithmic coordinates, by a straight line parallel to the straight line representing the regression of grades in radioactivity. An evaluation was made of uranium reserves. The precision of the evaluation of the ore content is discussed. (J.S.R.)

6618 A/CONF.15/P/1247
DEVELOPMENT OF THE URANIUM MINING INDUSTRY IN FRANCE AND IN THE FRENCH UNION. Jacques Mabile (Commissariat a l'Energie Atomique, Paris). 7p.

A brief historical sketch is presented of the uranium discoveries made in France and the French Union. The present situation with respect to the mining of known deposits is summarized, and the probable future development is indicated. (J.S.R.)

6619 A/CONF.15/P/1249
METHODES DE PROSPECTION AUTOPORTEE ET AEROPORTEE; LA TECHNIQUE DE LA DETECTION DES RAYONNEMENTS; LES PERSPECTIVES OFFERTES PAR LA DISCRIMINATION DES ENERGIES. (Carborne and Airborne Prospecting Methods; Radiation Technique; New Prospects for Discriminating Energy.) J. Berbezier, B. Blangy, J. Guitton, and C. Lallemant (Commissariat à l'Énergie Atomique, Paris). 38p.

The methods used in carborne and airborne prospecting for uranium by the Commissariat a l'Energie Atomique are described. The radiation detection instruments for carborne prospecting are discussed and compared. The equipment used in airborne prospecting are described. The results obtained are given, and the cause of the parasitic effects is discussed. A scintillation detector used in aerial prospecting is described. The gamma spectrum of radioactive anomalies and its deformation by absorption in air was studied to aid in the discrimination and selection of radiation energies for the immediate identification of uranium and thorium occurrences on board the plane. Characteristics of the detector needed for the discrimination are given. (J.S.R.)

6620 A/CONF.15/P/1250
COMPORTEMENT GEOCHIMIQUE DE L'URANIUM DANS LE CYCLE DEALTERATION. (Geochemical Behaviour of Uranium in the Cycle of Alteration). Jean Chervet and Rene Coulomb (Commissariat à l'Energie Atomique, Paris). 14p.

Preliminary results on an investigation of the genesis of secondary uranium mineralizations are reported. Experimental results on the solubility of secondary uranium minerals, e.g., autunite, parsonsite, kasolite, chalcolite, and pyrite-pitchblende, are reported. The form of the uranium in solution was investigated. Water circulation in granite batholiths and its effect on the composition of the granites were studied. The results of a study of the water of five wells in the region of Verneix where there is an anomalous distribution of uranium are reported. The phenomena limiting the dispersion of uranium are discussed. (J.S.R.)

6621 A/CONF.15/P/1302
THE USE OF RADIOACTIVE TRACERS IN OIL EXTRACTION IN ROMANIA. G. I. Peteou (Ministère de l'Industrie du Pétrole et de la Chimie, Bucharest). 13p.

In the extractive oil industry in Rumania, the radioactive methods used for the investigation of drill holes by radioactive coring, as well as the processes using radioactive isotopes as tracers, found a number of applications which give significant scientific and economic results. The work carried out by means of radioactive tracers in the test holes is reviewed with regard to: determination of the areas of communication between the layers outside the columns which have received tubing or casing and concrete; monitoring of concrete pouring under pressure; monitoring of water injection into the layers; and localization of the cracks formed by hydraulic fracturing. (W.D.M.)

6622 A/CONF.15/P/1303
SUR QUELQUES RESULTATS OBTENUS A L'EXPERIMENTATION DE LA PROSPECTION RADIOACTIVE POUR LE PETROLE ET LES GAZ, EN ROUMANIE. (The Results of Experiments on Radioactive Prospection for Oil and Gas in Romania). D. P. Bigir (Ministère de l'Industrie du Pétrole et de la Chimie, Bucharest). 7p.

The results obtained for emanometric and radiometric prospecting for gas and oil in Rumania in 1956 and 1957 are presented. The methods used are described. The physical principles of radiometric and emanometric anomalies are discussed, and laboratory and field experimental work on these principles is reported. (J.S.R.)

6623 A/CONF.15/P/1305
SUR L'EMPLOI D'UNE THEORIE ALGEBRIGUE POUR LA FONDAMENTATION DE LA METHODE GENERALE D'EXECUTION DES TRAVAUX DE PROSPECTION ET D'EXPLORATION DES GISEMENTS DE METAUX RARES. (On the Use of Algebraic Logic in the Development of a General Method Regarding the Performance of the Prospection and Survey Work in Rare Metal Deposits.) I. Lari and N. Mihailovici (Rumania). 32p.

A general method, based on the use of algebraic logic and group theory, is developed which offers the possibility of determing the smallest number of work assignments which must be carried out to determine the volume, the useful mineral content, and the distribution of minerals in a given geological structure. The analysis shows that there exists a qualitative analogy between the distribution of mineralization in the deposits and the specific probability problems of quantum mechanics. (J.S.R.)

6624 A/CONF.15/P/1356
GENESIS OF THE URANIUM DEPOSIT IN TERTIARY SEDIMENTS IN THE NINGYÔ-TÔGÉ AREA, WESTERN JAPAN. Nobuo Katayama (Tokyo Univ.). 9p.

The uranium ores of the Ningyo-toge deposit occur in the terrestrial sedimentary rocks of the Ningyo-toge formation. Since the age of the formation is young, probably late Miocene or early Pliocene, the deposits have not suffered significant alterations. A syngenetic origin of the uranium in the lacustrine sediments of the Ningyo-toge is highly probable because the uranium is distributed homogeneously through a single stratum, and the uranium content decreases abruptly from the laminated mudstone at the top of the Ningyo-toge to the overlying massive mudstone of the Takashimizu, despite the fact that the two mudstones have the same mineral constitution. It is thought that the uranium has a supergene origin because the region around the Ningyo-toge basin is composed of granite batholith which had cropped out in a semiarid climate. The history of the deposit is compared with the uranium deposits of the Colorado Plateau on Witwatersrand types. (J.S.R.)

6625 A/CONF.15/P/1357
CHEMICAL PROSPECTING OF URANIUM DEPOSITS IN JAPAN. Yukio Murakami (Tokyo Univ.), Shizuo Fujiwara (Univ. of Electro-Communications, Tokyo), Motoo Sato and Shuji Ohashi (Atomic Fuel Corp. of Japan, Tokyo). 22p.

In Japan, natural waters, soils and rocks, and plants have been selected as the objects for the chemical pros-

pecting of the uranium deposits. Two methods (direct and indirect) have been used. The direct method consists of the fluorimetric determination of uranium contents in these samples and finding out the possibilities of the occurring location of the uranium deposit. The indirect method is so called because uranium occurs indirectly through the results of some elements other than uranium. In this study it was found that zinc and phosphate have a close relation with the occurrence of uranium. (auth)

6626 A/CONF.15/P/1359
ON THE RESULTS OF PROSPECTING FOR THE PROMISING URANIUM DEPOSITS IN JAPAN. Motoo Sato (Atomic Fuel Corp., Tokyo). 18p.

The discoveries of uranium deposits of non-pegmatite type in Japan were reported from 40 localities in the past three years. Several of these localities which are regarded as promising uranium resources are being prospected in depth by means of underground driving. The outline of the results of the prospecting is as follows. The Ningyo-toge uranium deposit occurs in the basal conglomerate of Neogene Tertiary stratified almost horizontally on a granite basement. This uranium-bearing conglomerate, extending over 7,000 m from east to west, is distributed nearly persistently on the peneplain of the Chugoku Massif. In the Ningyo-toge area, it is being proved that a chemical prospecting by surface water determination is effective for tracing the distribution of deposits. At present, prospecting galleries are driven in some part of the area. And, as a result, it has been known that uranium concentration is observed in hollows of the unconformity plane, namely in presumable channels of an ancient lake bottom, judging from the correlation of isobathy contours of unconformity plane and assay map. Autunite is crystallized in outcrops and places where surface overburden is thin, and even in depth it occurs locally in faulted zones forming a small bonanza. Uranium is contained generally more in the conglomerate of small pebbles than in that of larger pebbles. In the areas of Kurayoshi and Miyoshi, coffinite was found at the depth of 40 to 50 m below the surface where zeunerite or autunite had already been found. For the tracing of those veins occurring in sheared zones of granite, electric prospecting such as resistivity method has proved to be effective. (auth)

6627 A/CONF.15/P/1360
SUMMARY OF GEOLOGY AND MINERALOGY OF THE URANIUM AND THORIUM DEPOSITS IN JAPAN. Tsukasa Murakoshi and Kōji Koseki (Geological Survey of Japan). 27p.

For a number of years, the occurrences of uranium and thorium minerals known in Japan were limited to those of pegmatitic origin and almost all of them were merely of mineralogical or geochemical interest. At present, various types of uranium and thorium deposits are known in Japan and they include not only those of the above-mentioned types of pegmatitic origin but also deposits which were considered to be lacking in Japan such as the sedimentary deposits and those associated with metallic ore deposits. All of these new discoveries were made by exploration and researches carried out during the last two or three years. Although the types of some of the deposits are not yet clarified definitely and further revision may be necessary, the classification and the examples of the uranium and thorium deposits of Japan are as follows: pegmatite deposits; pneumatolytic to hydrothermal deposits; pyrometasomatic deposits; hydrothermal deposits; sedimentary deposits; and placer deposits. The results obtained by geological and mineralogical researches on the main deposits of each type are summarized. (auth)

6628 A/CONF.15/P/1398
PRECISE RADIOMETRIC DETERMINATIONS OF URANIUM AND THORIUM CONTENTS IN ORES. S. Sciuti (Istituto Nazionale di Fisica Nucleare, Rome) and D. Prosperi (Comitato Nazionale per le Ricerche Nucleari, Rome). 21p.

The application of various radiometric methods to the assay of U and Th in ores is discussed. The methods used, integral β and γ counting and differential γ spectroscopy, are described at length. (W.L.H.)

6629 A/CONF.15/P/1419
RADIOACTIVE MINERALIZATIONS IN THE CENTRAL REGIONS OF SPAIN. M. Alía, J. L. Rebollo, J. A. Fernández Polo, C. Bonet, and F. de Pedro (Junta de Energía Nuclear, Madrid). 14p.

The prospecting carried out to date has revealed the presence of radioactive mineralizations in the regions of Central Spain, in the Cordillera Central, and in the Tertiary of the Tagus Depression. The Cordillera Central is made up, in the region studied, of the Gredos and Guadarrama ranges. They both consist of granitic and metamorphic rocks of Hercynian origin. The Alpine movements account for the rise of the blocks which make up this range, usually as a series of horsts. Three different types of radioactive mineralizations are described: in micacites, aplites, and veins. A geological study, complemented by a morphological, particularly tectonic, review, warrants the conclusion that, during the Hercynian cycle, there was a first uraniferous concentration in the more acid eruptive rocks, then a subsequent and more localized one at the favor of the stress structures of Alpid origin. It is believed that the mineralizations find their origin in the leaching of strata which are richer in radioactive minerals, with concentration taking place where various favorable levels and structures are present. (auth)

6630 A/CONF.15/P/1420
RADIOACTIVITY OF THE BATHOLITH AT PEDROSO, SEVILLE PROVINCE, SPAIN. L. C. García de Figuerola and E. Ramírez (Junta de Energía Nuclear, Madrid). 7p.

The Pedroso batholith is found in the Northwestern Province of Seville, and it is made up of granitic rocks of various types, among which the coarse grain biotitic varieties are predominant. In most instances, they give very high radioactivity readings. This batholith is surrounded by metamorphic rocks, principally micaceous, with Paleozoic limestones (of the Cambrian and Silurian ages) which also give a high radioactive background in many instances. A tectonic and stratigraphic study of the adjacent areas indicates the existence of very marked movements which date back to an earlier period than the Permian-Triassic epoch and others, of a later date, which reactivated the old breaks. These did not affect the Upper Tertiary. Similarly, they did not give rise to the formation of structures favorable to uranium mineralization. Fairly extensive iron and copper deposits are to be found at the point of contact between the batholith and the country rocks, but these do not contain any appreciable amounts of radioactive elements which, naturally, are present in smaller proportions than in the granites and metamorphic rocks. It is felt that these deposits are a "basic front" and

that the uranium was mobilized, neither at the same time as the femic components, during the formation of the granite, nor at a subsequent epoch through a rheomorphic process. (auth)

6631 A/CONF.15/P/1437
PRELIMINARY REMARKS ON THE DETERMINATION OF URANIUM. IN AUSTRIAN SPRINGS AND ROCKS. Friedrich Hecht (Univ. of Vienna), Heinrich Kupper (Austrian Geological Survey and Univ. of Vienna); and Walter E. Petrascheck (Mining-Univ. of Leoben, Austria). 6p.

A long-term program for prospecting for fissionable materials has been devised by the Geological Survey of Austria. So far hydrogeochemical prospecting for U has been used together with the exploration of rocks and coal. Results are given of U concentrations in waters, rock formations, and coal deposits. (W.L.H.)

6632 A/CONF.15/P/1485
THE DISCOVERY OF URANIUM ORES IN EGYPT. (Egyptian Atomic Energy Commission, Cairo). 14p.

Geological and radiometric surveys in both the Eastern and Western Deserts are described. Results of discoveries in each area are given. Impregnations of uraniferous-siliceous solutions are discovered in Oligocene formations in Katrani Area, Western Desert. Detailed chemical and mineralogical studies of the ores are given together with an attempt to correlate their genesis to the tertiary volcanic activities known to occur in the vicinity. Parts of the Miocene and Cretaceous formations of the Eastern Deserts are surveyed. Uraniferous mineralization in cretaceous marls is recorded. A discussion of the uranium mineralization in these marls as compared to that in the overlying phosphatic beds is given. Detailed chemical and mineralogical studies are given, and possible origin of maximum mineralization is considered. (auth)

6633 A/CONF.15/P/1486
A STUDY OF THE EGYPTIAN MONAZITE-BEARING BLACK SANDS. R. A. Higazy and A. G. Naguib (Egyptian Atomic Energy Commission, Cairo). 16p.

Geological and radiometric surveys along the whole Mediterranean beach of the Nile Delta proved the occurrence of differential deposition of the various minerals of black sands. The nature of deposition of the black sands are described. Mineralogical composition and mechanical analyses of different samples are given. A discussion of the nature of deposition of the black sands is included. (auth)

6634 A/CONF.15/P/1508
URANIFEROUS NEPHELINE SYENITES AND RELATED ROCKS IN THE ILIMAUSSAQ AREA, JULIANEHAAB DISTRICT, SOUTH WEST GREENLAND. J. Bondam (Geological Survey, Greenland) and H. Sørensen (Copenhagen Univ.). 12p.

Concentrations of radioactive minerals are found in the eudialyte-bearing nepheline syenites of the Ilimaussaq complex in South West Greenland. The radioactive minerals may occur as accessories in the melanocratic nepheline syenite, called lujavrite. The lujavrite is considered to be the youngest rock of the complex, in which it occupies a considerable volume. The U content averages about 150 ppm. In restricted areas concentrations of 500 to 2000 ppm have been found. The Th content is 2 to 7 times that of U. Radioactive minerals may also occur as local concentrations in inclusions of older, recrystallized nepheline syenite in the lujavrite and as concentrations in recrystallized zones of deformation in some of the oldest nepheline syenites of the complex. Only the lujavrite may be considered as possible low-grade U and Th sources. The other occurrences are mainly of genetical interest. The most important radioactive mineral is steenstrupine, with about 0.3% U and 2.7% Th. Steenstrupine may alter to various poorly defined radioactive alteration products. Monazite, britholite, microlite, and thorianite have been found in small amounts. The eudialyte of the nepheline syenites is faintly radioactive. Steenstrupine is found in rocks, in which the eudialyte has been altered hydrothermally. (auth)

6635 A/CONF.15/P/1560
THE MALARGUE URANIUM BEARING DISTRICT, IN THE SOUTH OF THE PROVINCE OF MENDOZA. Marcelo R. Yrigoyen (Comisión Nacional de Energía Atómica, Buenos Aires). 20p.

A vast uraniferous belt begins in the area of Malargüe and extends to the South over a distance of some 350 km. Its Northern end contains a region characterized by the existence of several deposits of interest which are currently being worked. A series of radioactive occurrences are to be found in the lower half of the Middle Cretaceous (Diamantian) around the closures of the anticlinal structures of Malargüe and Pampa Amarilla. The rest of the local sedimentary mass also is to be found inside the zone, from the upper Triassic to the Quaternary, with a covering, in the latter, of ignimbritic tuffs showing high radioactivity. The series of igneous rocks is represented by granites, porphyrites, and triassic porphyrites, and acid and basic vulcanites of the Cenozoic age. The uraniferous deposits correspond to concentrations of carnotite, uranophane, and tyuyamunite which dominate among the secondary minerals, and pitchblende among the unoxidized ones. They are accompanied by copper sulfides and carbonates and iron minerals. The deposition corresponds to hydrothermal solutions which have precipitated the uraniferous varieties within the sandstony sediments, which contain much bituminous material (asphalt), of the Middle Cretaceous. Structurally speaking, the deposits are found where they are supposed to be, since they are confined to specific sectors by considerations of porosity and permeability. (auth)

6636 A/CONF.15/P/1561
A CONTRIBUTION TO THE KNOWLEDGE OF THE URANIFEROUS LUTITES OF THE PROVINCE OF SAN JUAN (ARGENTINA). Victorio Angelelli and Armando Ortega (Comisión Nacional de Energía Atómica, Argentina). 17p.

Outcroppings of uranium-bearing lutites are to be found in the Western fold of the San Juan foot-hills. These sediments, which are a part of the eopaleozoic formations which constitute the foot-hills, make up a large area of such outcroppings. Their thickness varies from some tens to some hundreds of meters, according to the location. The dominant orientation is North-South, with a variable dip. In some areas, they are folded and very much broken (Calingasta). They are finely stratified, pitch black to greyish black in color, when altered. They consist, in the main, of clayey material, organic matter, and quartz, with some carbonates, pyrite, hematite, and sericite. Their composition is not homogeneous, as shown by microscopic and chemical analyses. These sediments are of marine origin, and seem to belong to the Ordovician. In some

parts, they contain fossils. Their U_3O_8 content, as determined fluorometrically, varies between 20 and 30 grams per ton. (auth)

6637 A/CONF.15/P/1591
RADIOACTIVE WELL-LOGGING IN HORIZONTAL BOREHOLES FOR PROSPECTING FOR POTASSIUM SALTS. J. Czubek, B. Dziunikowski, L. Jurkiewicz, J. Krzuk, J. Niewodniczanski, T. Owsiak, K. Przewłocki, and A. Zuber (Polish Academy of Sciences, Krakow). 9p.

Because of low gain (60 to 70%) of bore core by drilling the horizontal boreholes in the parts of the salt dome where potassium salt beds are present, it was advisable to apply some geophysical method which might give the geologist necessary information about the accurate location of the discovered beds, their thickness, chemical composition, industrial value, etc. The only method which could be applied was the radioactive logging (natural γ- and β-ray logging and n-γ logging). For the investigation of boreholes 66 mm in diameter drilled in horizontal direction to about 200 m, equipment was used consisting of a probe device with GM counter, an integrating circuit with a self-registering milliammeter, an oscilloscope, etc. (auth)

6638 A/CONF.15/P/1613
USE OF RADIOISOTOPES IN STUDIES OF GROUND-WATER FLOW. I. LABORATORY AND FIELD EXPERIMENTS ON THE SUITABILITY OF VARIOUS TRACERS. E. Halevy and A. Nir (Weizmann Inst. of Science, Rehovoth, Israel); Y. Harpaz and S. Mandel (Water Planning for Israel, Ltd., Tel Aviv). 9p.

The suitability of various radioactive isotopes for ground water tracing was investigated in a series of laboratory experiments. Isotopes investigated were I^{131} (KI as carrier), Zn^{65} (in versene), Cl^{36} (as NaCl), and Ir^{192} (Ir^{3+} in versene and $IrCl_6^{3-}$ with cobaltinitrite as carrier). A small-scale field experiment was performed using I^{131}. Ground water in a limestone aquifer was traced between two wells, 50 meters apart. The results permitted the determination of some hydrological characteristics of the aquifer. The radioactivity was detected with a large-volume liquid scintillator, having a sensitivity of 2×10^{-10} c/l of I^{131}. (auth)

6639 A/CONF.15/P/1614
USE OF RADIOISOTOPES IN STUDIES OF GROUND-WATER FLOW. II. ON THE CHARACTERISTICS OF TRACER PULSE SHAPE. E. Halevy and A. Nir (Weizmann Inst. of Science, Rehovoth, Israel). 10p.

Several theoretical approaches to the problem of ground water tracing are analyzed. Characteristics of pulse shapes resulting from two different simple models are summarized and compared with laboratory results. General conditions for the validity of both models are then proposed, dependent on flow velocity, geometry, and effects of molecular diffusion. Examples for the calculation of pulse shapes and model experiments for the investigation of aquifer characteristics are given. (auth)

6640 A/CONF.15/P/1661
URANIUM DEPOSITS OF CENTRAL MEWAR. K. K. Dar and H. Nandi (Dept. of Atomic Energy, India). 15p.

Among the more recent finds of uranium ore in the Aravalli phyllites and schists of Rajasthan, mention should be made of (1) the pitchblende deposit at Umra and (2) uranium ore of Udaisagar, both on the eastern flank of the Aravalli geosyncline. At Umra, the country rock is a black to grey chlorite-phyllite. It is occasionally associated with partings of carbon-phyllite, and contains inconstant lenses of dolomitic limestone towards the upper part of the succession. The phyllite series is succeeded dolomitic limestone. The rocks are isoclinally folded with a general easterly or south-easterly dip. The phyllite-limestone contact on the west bears the impress of local movement. An anticlinal fold with a high southerly pitch is recognized in the phyllite in the immediate neighborhood of the limestone contact where surface indications of mineralization were observed. Additional ore bodies have been located further east on two other strike ridges of similar phyllite. Old copper workings and malachite and azurite staining are present in the area. The major uranium mineralization is independent of the copper lodes, though some activity is noted in the old copper workings. In the early stages of pitting and trenching, ore analyzing 5 to 10 per cent and even up to 37 per cent was obtained. Core drilling, however, proved it to be discontinuous, as 70 per cent of the holes did not pass through the dip extension of the ore seen at the surface, though some fresh mineralized zones were picked up. Adits run at depths of 50 to 70 feet below the outcrop level have yielded a better picture of the deposit, several new ore shoots and mineralized shear zones four to five feet wide having been encountered. The data furnished a basis for a revised drilling and development program. The primary ore is pitchblende/uraninite, cubical crystals of the latter being visible to the naked eye and in thin and polished sections. The minerals accompanied by rims of orange and yellow "gummite" sometime occur in one to a quarter inch thick massive veins in highly discolored, structureless, and dense clayey substance of a pinkish cream, buff, or light green color, being an alteration product of phyllite. Torbernite and autunite are also commonly met with at or near the surface. A number of prospects have been located in the neighborhood of Udaisagar. The geology of the two areas is similar except that they are zones of pronounced silicification representing fault planes, and also that carbonaceous rocks from a dominant member of the phyllitic suite in the vicinity of Udaisagar. As at Umra, the area bears traces of copper ore. Uraninite occurs mainly in the chlorite phyllite near its junction with the overlying carbon phyllite, and also along planes of fracture in the silicified zones in which the mineral was precipitated along with manganese and iron oxides. (auth)

6641 A/CONF.15/P/1662
MONAZITE SANDS OF BIHAR AND WEST BENGAL. V. G. Shirke and B. D. Chatterji (Dept. of Atomic Energy, India). 7p.

Large monazite placers with other associated minerals, e.g., ilmenite, rutile, sillimanite, zircon, etc., are known to occur in the western and eastern seaboards of India. Lately similar sands have been discovered in inland areas in the older alluvium capping the Ranchi Plateau in Bihar and in similar formations in the extensive low lying plains of Koleibera to the south, and in parts of Hazaribagh district to the north, in the plains of Purulia to the east, in the state of Bihar and to a minor extent also in the adjacent areas in Burdwan and Bankura districts in West Bengal. Columbite-tantalite is often an additional constituent of the inland heavy mineral sand in which rutile is also

more abundant than ilmenite. A program of sampling has been introduced on the basis of isorad maps which roughly demarcate the in situ active from non-active areas, and also according to different orders of activity in the active patches. Much barren area has thus been eliminated, and sampling is being confined to areas of higher activity only. The survey is not yet complete, but the work done so far indicates that the concentrates are economically workable over twenty square miles in the portion of the belt already surveyed. (auth)

6642 A/CONF.15/P/1663
PROSPECTING AND EVALUATION OF BEACH PLACERS ALONG THE COASTAL BELT OF INDIA. V. Mahadevan, G. R. Narayana Das, and N. Nagaraja Rao (Dept. of Atomic Energy, India). 8p.

The Atomic Minerals Division has been engaged, since 1950, in the survey of the beach sands on the southwestern coast of India. The reserves of monazite up to a depth of 25 ft have been estimated at 1.4 million tons, and those of ilmenite at 52.5 million tons. It is not known, however, to what further depth workable concentrates may be found. Preliminary survey has indicated the presence of monazite and other heavy minerals on the sea bed within half a mile of the west coast and also on the beds of inland lakes. The proportion of heavy minerals is lesser on the east coast. The hinterland, consisting of gneissose crystallines, heavily intruded by the pegmatites, is the primary source of the heavy minerals. The drainage pattern, topography, climate, and coastal configuration determine, to a large extent, the deposition of these placer minerals. For delineation of the zones containing appreciable monazite, samples are drawn at regular intervals in a grid pattern and the weight percentage in each sample is plotted against the respective grid station and isopach lines drawn to demarcate the barren from the rich zones. Reserves are calculated following conventional procedures. (auth)

6643 A/CONF.15/P/1664
OCCURRENCE OF URANIUM IN PEGMATITE, IN RAJASTHAN, INDIA. G. R. Udas (Dept. of Atomic Energy, India). 8p.

The uraninite pegmatite is zoned and occurs at Bhunas in Rajasthan and is intrusive into the Aravalli schists of Archaean age. From its hanging wall contact with the mica schist inwards, ruby mica of commercial quality is prevalent. Further inwards and towards the footwall side of the mica working occurs a shear zone with a predominance of green mica of no commercial value. Microcline is the characteristic feldspar in the green mica zone. The uranium minerals in the green mica zone are cyrtolite and uraninite. They sometimes occur in large chunks weighing as much as 40 pounds. Smaller grains occur as disseminations in the matrix, and uraninite particularly as fine particles in between mica lamellae. The associated quartz is generally smoky and translucent. Minor quantities of autunite and rarely metatorbernite appear as stains on other minerals. Petrological investigations and the study of autoradiographs revealed that uraninite occurs as minute stringers also within cyrtolite, uraninite can be separated by crushing the ore to minus 80 mesh. Chunks of uraninite and cyrtolite that can be easily handpicked, constitute roughly 1% of the run of the mine ore. It is fairly easy and reasonably economical to remove large lumps of barren quartz and feldspar and obtain a concentrate of an average 0.25% grade. Further concentration of the material to a grade containing 3% of U_3O_8 was effected by gravity separation at 85% recovery. Following the clue offered by this mineral association at Bhunas, pegmatites in the district are being re-examined and already several new occurrences have been brought to light where detailed investigations are now in progress. (auth)

6644 A/CONF.15/P/1665
URANIUM ORE DEPOSITS AT JADUGUDA IN BIHAR STATE, INDIA. K. L. Bhola, G. R. Udas, N. R. Mehta, and G. H. Sahasrabudhe (Dept. of Atomic Energy, India). 9p.

Among the several prospects for uranium minerals under investigation in the copper belt of Singhbhum in the state of Bihar, two large continuous deposits of the order of two million tons each have already been indicated by bore holes and partly proved by development work. One of them at Jaduguda is discussed. The surface ore consists mostly of the secondary minerals autunite and torbernite but in depth uraninite takes their place. Commonly associated minerals are apatite, magnetite, and ilmenite. Hematite seems to replace magnetite in the surface and near surface ore. Locally copper sulfide minerals are also associated as in the Mosaboni copper mines, the mill tailings showing small but appreciable activity. Traces of zirconium and vanadium are also present. Strikewise the ore body has already been proved over a length of 3,500 feet and vertically to a depth of 1000 feet. The ore body is of a variable thickness ranging between 15 to 3½ feet. It behaves as a continuous sheet with a general northerly dip of 55°. The deep bore holes generally show an enrichment of uranium with depth. Bore hole operations continus to extend the limits of the ore body both along the dip and strike. The leaching process applied to the milled surface ore had to be modified for treating the unaltered ore. Combined gravity and magnetic separation form the main part of the process of beneficiation. (auth)

6645 A/CONF.15/P/1666
OCCURRENCES OF BERYLLIUM AND ZIRCONIUM IN INDIA. D. N. Wadia (Dept. of Atomic Energy, India). 5p.

Indian beryl has a consistently high proportion of 11 to 13% BeO. Generally, the occurrence of beryl is confined to pegmatite dikes, of a highly capricious nature, in acid granites and gneisses of the Dharwar basement complex (huronian); the exact age of the pegmatite is, however, believed to be post-Delhi (Algonkian). The more productive beryl deposits are found in Bihar, parts of Rajasthan and Madras. Here beryl occurs at the edges of the prominent quartz cores of pegmatites and in the feldspathic rim surrounding it. Columnar beryl crystals 15 to 20 ft long and 4 ft across weighing over 20 tons have been mined. The beryllium is of primary magmatic origin in these rocks. There is no evidence of hydrothermal origin, nor of its genesis from basic magmas. Production of beryl in India was insignificant before the war, but since 1949 the annual output has been in some years 2000 to 3000 tons. Since 1946 an embargo on export exists, the output being stockpiled. A large part of beryl mined in India is eluvial, or quarried from shallow pits. The reserves in India are substantial, but increasing cost of production may limit supplies. Beryl mining is tied up with mica production, and as long as India preserves its lead as the world's largest producer of mica, a moderate but steady supply can be counted upon. India

possesses large reserves of zircon, the principal ore (ZrO_2, 66%), in extensive detrital littoral deposits on the West and East coasts, associated with ilmenite and monazite. There are besides large placer deposits in some parts of Bihar. Zircon forms as much as 7% of these raw ilmenite beach sands and placers. A reserve of considerably over 15 million tons is estimated. Baddeleyite (ZrO_2, 88%) and cyrtolite occur but are of no commercial importance. The production of zircon, varying from a few hundred to few thousand tons, is from the nonmagnetic tails left in the processing of ilmenite and monazite beach sands at Travancore. (auth)

6646 A/CONF.15/P/1720
MINÉRAL DE CHROME URANIFERE ET SON RÔLE PARAGENETIQUE DANS L'ENSEMBLE PERMIEN DU MECSEK. (An Epigene Chrome Mineral and its Paramagnetic Role in the Uraniferous Permian Series of the Mecsek Mountains.) J[ean] Kiss (Loránd Eötvös Univ., Budapest). 25p.

In the Lower Permian development of the Mecsek Mountains there occurs a clastic series, the thickness and color of which show considerable variations. The lowest bed is rich in organic components, the second, green, series is characterized by the frequency of Cr and Ba occurrence, and in the third an enrichment in iron, calcium, and magnesium can be detected. The considerable enrichment of Cr and the geochemical role of the middle series is discussed. The correlation of Cr–U and Cr–V and an emerald Cr mineral of epigenic origin are considered in detail. (J.S.R.)

6647 A/CONF.15/P/1721
LA GENESE ET LE CARACTERE PETROGRAPHIQUE SÉDIMENTAIRE DE L'ENRICHISSEMENT DE MINERAI D'URANIUM DANS LA MONTAGNE MECSEK. (Data on the Problem of the Genesis of the Minerals of the Uranium Deposits of the Mecsek Mountains.) A. Barábás and J[ean] Kiss (Loránd Eötvös Univ., Budapest). 33p.

The Lower Permian sedimentary series of the Mecsek Mountains is characterized by a triple petrographic development, which is shown also in its enrichment in radioactive elements. This triple petrographic division is also shown by the mineralogical and chemical compositions. An examination of the minerals and trace elements indicates that the development of the Mecsek Mountains represents the product of erosion of a Bi–Co–Ni formation, the lower and middle groups of which correspond to the veins of the Bi–Co–Ni formation of the metamorphic rocks covering the plutonian granites. The upper development probably represents the primary perimagmatic and intramagmatic part of the deposit, together with its pegmatitic products. (J.S.R.)

6648 A/CONF.15/P/1722
SUR UN CAS CARACTERISTIQUE DE LA MIGRATION D'URANIUM OBSERVEE DANS LA MONTAGNE LITTORALE DU BALATON. (A Uraniferous Bituminous Limestone Series in the Balaton Highlands.) B. Jantsky, J[ean] Kiss, S. Lengyel, D. Szy, and K. Virágh (Hungarian State Geological Inst., Budapest). 18p.

Aerial and automobile surveys along the northwestern shore of Lake Balaton revealed the presence of high radioactivity. Detailed geological mapping was done and the presence of uranium was detected. The area consists of sediments of Triassic age. The geological structure and the stratification of the bituminous complex is described. Dolomites, limestones, and bituminous marls were found with high uranium and fluorite concentration. All these are connected with fractured structures. (J.S.R.)

6649 A/CONF.15/P/1800
URANIUM MINING IN SPAIN, CURRENT STATUS AND PROSPECTS. D. Santana Pérez (Junta de Energia Nuclear, Madrid). 17p.

The results obtained in the mining research work conducted in the most interesting radioactive areas of Spain are reviewed. A brief mention is made of the work already carried out and of that which is now still under way, as well as of future plans in the areas of research and actual working of the mines. A study is presented of the known veins and mineral associations, as well as an analysis of the economic potentialities of each of these occurrences. The prospects of radioactive substance mining in Spain are reviewed in the light of the results achieved. (auth)

6650 A/CONF.15/P/1803
THE GEOCHEMICAL PROCESS OF ALTERATION OF PRIMARY URANIUM ORES AND THE ELECTRON MICROSCOPIC STUDY OF THESE ORES. E. Mingarro and F. Catalina (Junta de Energia Nuclear, Madrid and Daza de Valdés Inst. of Optics, Madrid). 17p.

In order to determine the relationship of the minerals which are a product of alteration processes and predominant in the Spanish deposits with the pitchblendes considered to be the primary minerals and their mutual dependence, a method was developed based on a differential geochemical study of the pitchblendes and uranium phosphates, through a quantitative spectrochemical analysis of the chemical elements which are associated with the uranium in minute quantities. These geochemical associations persist in the hydrolysates, since the coexistence of the oligo-elements of pitchblende can be shown in the surface waters. An Fe–Cu–V and Ag–U diagram is drawn up, which shows, for each zone or geochemical group, the hydrothermal origin of the abnormalities in the uranium content. By resorting to electronic microscopy, a study was made of the elemental forms of the precrystalline and amorphous states of pitchblende in the various phases which intervene in its deposition. Use is made of the carbon replica technique on suspensions of particles of the mineral about 1 or 2 microns in size and the etched surfaces of polished preparations. (auth)

6651 A/CONF.15/P/1809
RESULTATS DES MESURES DE LA RADIOACTIVITE DES ROCHES LFFECTUEES DANS LES GALERIES DES AMENAGEMENTS HYDRO-ELECTRIQUES. (Results of Measurements on Radioactive Rocks in Galleries of Alpine Power-Station Projects). Th. Hügi and F. de Quervain (Commission pour la recherche en Suisse de minéraux et de roches a éléments radioactifs et rares, Bern and Zurich). 5p.

The construction of numerous hydroelectric stations in the Alps offers the possibility for the systematic measurement of radioactivity in geological profiles in hundreds of kilometers of gallery. The galleries were surveyed with a scintillation counter with readings being taken every 10 meters. Extensive records of the Aar and Gotthard massifs, the Pennine region, the Bergell massif, and in various Mesozoic and Tertiary sedimentary regions were made. The results obtained are tabulated for various rock series. (J.S.R.)

6652 A/CONF.15/P/1820
TRACING SAND MOVEMENT UNDER SEA WATER WITH RADIOACTIVE SILVER Ag−110. A. Gibert, F. Abecasis, M. Gonçalves Ferreira, J. Reis de Carvalho, S. Cordeiro (Ministério das obras Públicas, Lisbon). 10p.

The application of radioactive nuclides has proved very promising for studies of sand movements in the sea. A study is described which used 4 tons of sand labeled with 800 millicuries of silver-110 for tracing sand drift in a harbor and determining the passage of alluvium beyond a river mouth. Technological difficulties encountered are discussed. (C.H.)

6653 A/CONF.15/P/1824
NUCLEAR ENERGY GROUP. SOME RESULTS OF URANIUM PROSPECTION IN PORTUGAL. R. Cavaca (Junta de Energia Nuclear, Lisbon). 13p.

The special characteristics of the uraniferous deposits and the experience acquired during the first months of work enabled determination of coördinated working methods with the two-fold objective of obtaining both greater efficiency and greater economy in the various phases of prospecting. The modification of working methods and the results achieved up to December 1957 are discussed. (W.D.M.)

6654 A/CONF.15/P/1825
OCCURENCE DE MINERAIS D'URANIUM DANS LES FORMATIONS DE SCHISTES ANTE-ORDOVICIENS. (Occurrence of Uranium Ores in the Schist Formation of the Pre-Ordovician Portugal.) Carlos P. Lobato and Carlos N. Ferrão (Junta de Energia Nuclear, Lisbon). 17p.

The occurrence of uranium ores in concentrations of economical interest in the pre-ordovician schists was noted by the first time, in the region of Pinhel, in November 1956. The occurrence is situated in a zone of graphitic brown-greyish schists which are enclosed in a formation of gneiss with tourmaline near the contact of the latter with the hercinian granite, which constitutes the Beiras' Massif. The uraniferous mineralization is constituted by autunite down to the depth which has been reached by the exploration work. The radiometric study and the sampling taken at the depth of about ten meters suggest the continuity of the structure and the persistence of the mineralization associated with it. The structural type and the distribution of the mineralization in the joints and the brecciated zone of the schists suggest that the deposition of uranium ore is not syngenetic, but, rather, that it is attributed to the circulation of mineralized solutions through the breakage produced along the hypothermal veins, in a posterior reopening connected to the last movements of the alpidic orogenesis. The content obtained in the sampling reveals the existence of an enlarged ore deposit following the directions of the schistosity, with an extension of 140 meters and with the medium content of 0.27% U_3O_8. (auth)

6655 A/CONF.15/P/1952
BLACK SAND CONCENTRATES ALONG THE EAST COAST OF INDIA. C. Mahadevan (Andhra Univ., Waltair, India). 8p.

The results of a systematic study of the black sand concentrates occurring along the Andhra coast over a length of about 350 miles are reviewed, which disclosed several patches of concentrates of black sands along the beach down to a depth of about 5 feet. The heavy minerals consist of ilmenite, magnetite, sillimanite, garnet, zircon, monazite, etc. Detailed studies of beach profiles carried out in areas of beach sand concentrates clearly indicate that the extent of deposition of heavy minerals and the degree of their concentration at a given place are influenced by two major factors: orderly and predictable cycles of tides, waves, and currents and "cataclysmic" storms and high waves, the influence of the latter group being very profound since effected in a short duration. The beach concentrates are found to be richest after monsoonic months (November-February) and poorest in summer. Minerals derived from the drainage basins of streams emptying themselves into the Bay as well as inshore sediments are known to be the source material for the beach sand concentrates. (auth)

6656 A/CONF.15/P/1954
GROUNDWATER STUDIES IN NEW MEXICO USING TRITIUM AS A TRACER. Haro von Buttlar and Immo Wendt (Amt. für Bodenforschung, Hannover). 27p.

A new method for ground-water investigations is described, which employs tritium as a tracer. Tritium is produced in the atmosphere by cosmic radiation and hydrogen-bomb explosions, the latter causing large peaks in the tritium concentration of rain water. These peaks show up subsequently in underground water. Thus, an "apparent" age of ground-water samples can be determined, enabling inference as to hydrological quantities such as the rate of flow of aquifers and the size of recharge reservoirs. To demonstrate the feasibility of the method, measurements were made on ground-water samples from New Mexico. Since the tritium content of the samples was extremely low, the tritium was enriched by electrolysis and its concentration determined by the use of the low-level counting technique. (auth)

6657 A/CONF.15/P/2059
ROL SORBTSII V KONTSENTRATSII URANA V OSADOCHNYKH PORODAKH. (Sorption in Concentration of Uranium in Sedimentary Rocks.) E. V. Rozhkova, E. G. Razumnaya, et al. (U.S.S.R.). 32p.

The results of a study of the role of sorption processes in accumulating uranium in sedimentary deposits are discussed. A number of uranium-bearing sedimentary rocks were investigated. It was found that uranium is connected only with certain components of these rocks which proved to contain no uranium minerals. Assumptions were made as to the possibility of accumulation of uranium in these components as a result of sorption processes. At the second stage of investigation experiments were carried out with the sorption of uranium from the solutions of its salts. Experiments were made with the rock components under conditions which made it possible to determine the sorption capacity of these components and to establish the basic regularities of the sorption process. The comparison of the results of the first and second stages of the investigation indicates the possibility of uranium being accumulated in sedimentary rocks by sorption at various periods of their formation as well as in the process of epigenetic ore formation in sedimentary deposits. (auth)

6658 A/CONF.15/P/2060
NOVYE DANNYE O MINERALAKH URANA. (New Data Concerning Uranium Minerals.) Ts. L. Ambartsumyan and V. A. Polikarpova (U.S.S.R.). 63p.

Several new uranium minerals are described. The results are given of chemical, x-ray, and thermal analyses. A powdergram was obtained for hydrogen otenite $H_2(UO_2)_2(PO_4)_2 \cdot nH_2O$, which pointed to its com-

plete analogy with synthesized hydrogen otenite. The mineral of the coffinite type, found in association with sulfides as lens-shaped bodies among granites, differs from the well-known coffinite by the presence of not only quadri- but also of hexavalent uranium, as well as by the presence of rare earths (yttrium and ytterbium), calcium, and magnesium. The regularities of phase transformations in the course of heating phosphates, arsenates, sulfates, sulfate-carbonates, and other uranyl compounds are described. (auth)

6659 A/CONF.15/P/2066
GEOKHIMIYA URANA V ZONE IKISLENIYA RUDNYKH MESTOROZHDENII NA OSNOVE EKSPERIMENTAL'NYKH ISSLEDOVANII. (Geochemistry of Uranium in Oxidation Zone of Ore Deposits According to Experimental Data). V. V. Shcherbina (U.S.S.R.). 9p.

Investigations of geochemical processes in the oxidation zone of ore deposits and reproduction of these processes by experiment made it possible to reveal the nature of chemical reactions which account for the formation of uranium minerals in the oxidation zone of ore deposits. Superposition of later geochemical processes on the products of earlier processes, their stage of development, and the resulting mineralogical zonality are observed. The reactions proceeding in the oxidation zone of uranium ore deposits are as follows: hydrolysis; ionic exchange resulting in hardly soluble compounds; oxidation-reduction reactions; formation and destruction of complex compounds; and sorption processes. The nature of these reactions depends on humid or arid types of weathering. Examples of reactions that account for paragenesis of exogenous uranium minerals and their connection with endogenous mineralization are given. (auth)

6660 A/CONF.15/P/2082
THE FORM OF THE OCCURRENCE OF URANIUM IN SOME COALS. Z. A. Nekrasova (U.S.S.R.). 25p.

According to the prevailing theory concerning the forms in which uranium occurs in caustobioliths, uranium is found in coals mainly in the form of uranyl humates or other uranium organic compounds. The study of the uranium-bearing coals shows that these coals contain uranium partly in the form of typical oxides (pitchblende and uranium black powder) and partly in the finely dispersed form, which defies microscopic identification. A heavy residue rich in uranium has been extracted from the coals having finely dispersed form of mineralization by using a supercentrifuge. X-ray analysis of this residue showed that these coals contain uranium mainly in the form of oxides. The ratio of coal ash and uranium content, regularly increasing uranium content in highly oxidized coal varieties, and some other data give additional proof to the assumption that uranium occurs in coals mainly in the oxide form. (auth)

6661 A/CONF.15/P/2155
MINERALOGICAL TYPES OF OXIDATION ZONES OF HYDROTHERMAL URANIUM AND SULPHIDE-URANIUM ORES OF THE U.S.S.R. G. S. Gritsaenko, L. N. Belova, et al. (U.S.S.R.). 30p.

A comparative study of the mineralogy of oxidation zones of hydrothermal deposits of uranium ores and sulfide–uranium deposits of some uranium-bearing regions of the Soviet Union made it possible to establish the mineralogical types of oxidation zones which differ from each other in their mineral composition in general and in the character of uranium mineralization in particular. Types of oxidation zones are characterized. Specific deposits are not considered, and only the generalized results of the research are given. (auth)

6662 A/CONF.15/P/2201
PARAGENETIC ASSOCIATIONS OF HYDROTHERMAL URANIUM MINERALS IN URANIUM DEPOSITS OF THE SOVIET UNION. A. I. Tishkin, G. A. Tananayeva, et al. (U.S.S.R.). 69p.

Fibrous-radiated (acicular-fibrous) structure of the pitchblende grains is the primary structure of their growth. The crystallization nature of the pitchblende grains is also proved by the structure of the simultaneously growing crystals of calcite and spherolite of the pitchblende as well as by the structure of the metasomatic displacement of calcite by pitchblende spherolites. Structural features of the horizontal-layered aggregates ("mineralogical levels") as well as of other types of pitchblende deposition formed in open interstices show that even finest pitchblende spherolite formed in the solution sank by gravity. The presence of nodular aggregates of the pitchblende along the hanging vein wall excludes the assumption of the formation of even small portions (clots) of gels in the solution. Regular "crystals" of the pitchblende are seldom found. They are characterized by an elongated habitus and appear as prismatic crystals ended with a pyramid and basopinacoid. It is supposed that these crystals are of tetragonal (or even lower) syngony. In these crystals one can find some zonality of growth, block-structure, and signs of splitting. The pitchblende "crystals" are isotropic and have uraninite crystal structure. The lack of correspondence of the forms of the pitchblende crystals (tetragonal or lower syngony) and its structure (cubic lattice of uraninite) is considered as a pseudomorph of UO_2 and UO_3 or UO_2 and U_3O_8 on an unstable oxide of the type of U_4O_9, U_3O_7, and U_2O_5. The data concerning the pitchblende forms fail to prove the gel hypothesis of its origin but rather favors the assumption of the transport of uranium by true solutions. (auth)

6663 A/CONF.15/P/2245
GAMMA-EMANATSIONNYI METOD OTSENKI ANOMALII RADIOAKTIVNOSTI. (Gamma-emanation Method of Evaluation of Radioactivity Anomalies.) Yu. P. Bulashevich (U.S.S.R.). 14p.

Observations show that the relative coefficient of emanation leakage is a stable parameter which defines various types of rocks. Emanation anomalies are, as a rule, classified only by their radon or thoron nature. The value of the emanation leakage coefficient allows a more specific classification and the isolation of the following types of anomalies: those of content, of emanation leakage, and of gas halos. The evaluation of the emanation leakage of rocks in natural occurrence provides supplementary information on the material; as high emanation leakage is generally typical for finely-dispersed colloidal forms of occurrence of radioactive elements. (tr-auth)

6664 A/CONF.15/P/2421
THE URANIUM BEARING FORMATIONS OF THE SEDIMENTS OF THE LATE ALPINE PALEOZOIC. Felice Ippolito (Comitato Nazionale per le Ricerche Nucleari, Rome). 25p.

A general picture is presented of all the series of mineralization so far discovered in sedimentary and metamorphic formation of the late Alpine Paleozoic in Italy. Hypotheses are advanced on the genesis and the

possible relations which may exist among the different deposits. There are two types of uranium deposits in the western Alps. The deposits of one type were developed in the sedimentary environment of a shallow sea, scarce in oxygen and favorable to the preservation of the organic matter and to the precipitation of phosphates. The sediments deposited during the phases of rapid transgression, with little reworking of the continental deposits and with superimposition of thin layers of organic substance, have originated the deposits of the second type. The data on the mineralization of the central sector of the Alps are of a preliminary nature, but it is assumed that the uranium ore is in the form of "amorphous oxides" or organo-metallic complexes. The mineralization coincides exactly with a given tuffaceous stratum. A series of petrographic, geochemical, geological, and autoradiographic studies was made on the Permian-Carboniferous series of the eastern Alps. The radiometric investigations led to the discovery of various uranium concentration in specific strata of the arenites of the Val Gardena. The Val Daone deposit and the Val Rendena deposits are described. Hypotheses are advanced to clarify the factors which have determined the enrichment of uranium mineral, the age at which these phenomena occurred, and the origin of the uranium. (J.S.R.)

6665 A/CONF.15/P/2455
DETERMINATION OF RADIOACTIVITY OF SOIL AT DIFFERENT DEPTHS. S. M. Karim, F. Barendregt, and S. Siraj Ahmad (Univ. of Karachi, Pakistan). 11p.

An investigation was conducted to correlate the radioactivity in soils, beach sands, and rocks with their depth. The samples were taken at 100-ft intervals in an Indian oil well shaft and tested for radioactivity. Several months elapsed between sampling and testing; therefore, only the longer-lived radioactive substances were determined. The experimental apparatus is described, and the results are presented graphically. A discussion of all phases of the experiment is included. (J.R.D.)

6666 A/CONF.15/P/2482
SYNTHESE TECTONIQUE DE LA PROVINCE URANIFERE PORTUGAISE DISTRIBUTION DE LA MINERALISATION DANS LA REGION DE BEIRAS, PORTUGAL. (Tectonic Synthesis of the Portuguese Uranium District. Distribution of the Mineralization in the Region of Beiras, Portugal.) C. Pires Lobato (Lisbon). 36p.

The most important uranium deposits of Portugal are located in the Beiras Provinces. The large petrographic units of the region are porphoroid granites with two monzonitic micas which cover 40% of the area. Below the granites, whose age is Hercynian, there are graywack schist formations of pre-Ordovician age. Silurian formations are well developed. The Meso-cenozoic deposits exist in this region also. The Hercynian and Alpine orogeny has deformed and fractured all these formations, in particular the pre-Mesozoic formations. It has fractured the granite base following the tectonic lines which oriented the uranium ore distribution and the localization of the mineralized pockets. The structure and the tectonics of the district are analyzed. The role of the Hercynian and Alpine orogenies on the distribution of the most important mineral occurrences is emphasized. The systems and types of fractures which have oriented the mineralized zones are discussed. The relation of the mineralizing activity with the types of ore deposits, grouped with respect to the gangues, structure, and metasomatic phenomena of the encasing rocks, is noted. It is proved that there is a bond between the uranium ore deposits and the different systems of fractures. (J.S.R.)

6667 A/CONF.15/P/2492
GENERAL LAWS GOVERNING THE LOCALIZATION OF URANIUM MINERALIZATION AND THE BASIC TYPES OF STRUCTURES OF HYDROTHERMAL URANIUM DEPOSITS. I. P. Kushnarev, L. I. Lukin, B. L. Rybalov, E. P. Sonyushkin, and L. V. Khoroshilov (U.S.S.R.). 30p.

The general laws governing the localization of uranium mineralization are discussed. All provinces of hydrothermal uranium mineralization are adapted to sections of geosynclines which are characterized by an exceptional mobility. The noted tectonic features of the uranium-bearing provinces characterizing the final stage of their geosynclinal development predetermined the main structural features of the hydrothermal uranium deposits. The fissure type of structure prevails among these deposits. The distribution of ore fields of uranium deposits is determined by the folding and disjunctive disturbances as well as by the massifs of intrusive rocks which are nearest in time to the ore mineralization processes. As yet there is only scattered data on the depth of formation and vertical length of uranium deposits, but indirect indications suggest that hydrothermal uranium deposits are formed at no great depth. The structural types which reveal common features of connection between uranium hydrothermal deposits and local tectonic disturbances are classified. In examining the structural conditions of the localization of uranium ores in hydrothermal deposits, with a consideration of the role played by favorable rocks, eight main types of structures of ore bodies are distinguished. Each is described and briefly discussed. (J.S.R.)

6668 A/CONF.15/P/2499
SOME REGULARITIES OF URANIUM DISTRIBUTION IN UNDERGROUND WATERS. A. I. Germanov, S. G. Batulin, G. A. Volkov, A. K. Lisitsin, and V. S. Serebrennikov (U.S.S.R.). 52p.

The behavior of uranium and other elements in underground waters in some uranium-bearing regions has been investigated for several years by the authors and the results are partially shown. The influence of a number of agents on uranium distribution in underground waters is shown. The question of the effect of underground waters on uranium deposits is dealt with briefly, and a supposition is made on the possible role they play in the formation of deposits. (W.D.M.)

6669 A/CONF.15/P/2505
SOME THEORETICAL AND METHODICAL PROBLEMS OF RADIOMETRIC PROSPECTING AND SURVEY. A. G. Grammakov, N. V. Kvashnevskaya, A. I. Nikonov, et al. (U.S.S.R.). 33p.

Some theoretical problems of gamma logging and testing are discussed, as well as problems relating to field radiometric methods. The main features of application of these methods in prospecting uranium ores are discussed. (auth)

6670 A/CONF.15/P/2516
A SURVEY OF URANIUM AND THORIUM OCCURRENCES IN INDIA. K. L. Bhola, B. D. Chatterji, et al. (Dept. of Atomic Energy, India). 7p.

A brief account of the salient features of some of the uranium and thorium ore deposits in the process of development in India is presented. (J.E.D.)

6671 A/CONF.15/P/2519
LES GITES DE SWAMBO ET DE KALONGWE COMPARES A SHINKOLOBWE. (Comparison of the Ores of Swambo and Kalongwe with Shinkolobwe.) J. J. Derriks and R. Oosterbosch (Union Miniere du Haut-Katanga, Jadotville, Belgian Congo). 71p.

Swambo is a small uraniferous deposit discovered recently to the east of Shinkolobwe. The mineralization found is localized in the breccia and the "epontes" of a transverse fault affecting a layer of the ore series. This layer is part of an anticline alignment which can be followed from Shinkolobwe to Kalongwe and the length of which is level with the schisto-dolomitric stratum. The discovery of the ore deposit was made by the application of radiometric methods. A preliminary series of borings showed that the usable mineralization extends 125 m under the surface. The development by mining has gone to the hydrostatic level. From a genetic viewpoint, the ore deposit is similar to that of Shinkolobwe, but it is less important. Kalongwe is a cupro-cobaltic ore deposit lying to the southeast of Kolwezi. The deposit is principally localized in a fault which intersects a small layer of the ore series. The greso-dolomitic stratum at the base of this series is impregnated with powdered black uranium oxides in the neighborhood of the fault. The mineralization extends to 60 m of depth. The ore deposit was developed by mining to a depth of 42 m. The genesis of the deposit is comparable to that of Shinkolobwe, but the Kalongwe ores are distinguished by the relative abundance of copper and the absence of nickel. (tr-auth)

6672 A/CONF.15/P/2523
METEORITES AND EARTH CRUST: GEOCHEMISTRY OF ISOTOPES. A. P. Vinogradov (U.S.S.R.). 57p.

Data on the distribution of rare elements and isotopes of light elements in igneous rocks of the earth's crust and in various types of meteorites, as well as data on the zone melting of the silicate fraction of chondrites and other silicates, are used for the clarification of the genesis of various meteorite types as compared with the genesis of igneous rocks of the earth. The composition of stone meteorites is briefly discussed as an introduction to a consideration of the distribution of rare elements in various stone meteorites and igneous rocks. The isotopic composition of the carbon, oxygen, sulfur, and hydrogen content of igneous rocks and meteorites was investigated. Zone melting of chondrites and silicates gave further data on the composition of meteorites and igneous rocks. The probable common processes leading to the formation of igneous rocks and stone meteorites are discussed. (J.S.R.)

HEALTH AND SAFETY

6673 A/CONF.15/P/41
THE ALPHA-RAY ACTIVITY OF HUMANS AND THEIR ENVIRONMENT. W. V. Mayneord, J. M. Radley, and R. C. Turner (Royal Cancer Hospital, London). 12p.

The paper describes a simple technique for the measurement of alpha activity of a wide range of substances without elaborate chemical preparation. A new method has been devised for estimating the fraction of the total alpha activity due to members of the thorium series. Measurements have been made of the alpha activity of the bones of two radium workers and also patients to whom radioactive materials have been administered. Observations have also been made of the alpha-ray activities of skeletons of persons living in different parts of the United Kingdom; these include stillborn children. It is shown that there are some differences with geographical situation but very little difference in concentration with the age of the subject. Observations have also been made on a number of animals, types of soils and fertilizers and many other environmental materials some of which prove to have high thorium contents. Results are described of a balance experiment on a normal young human subject whose radioactive intake and excretion were measured daily over a period of a month. These studies involve the measurement of the alpha activity of all types of foods ingested by the subject as well as the activities of faecal samples. It is shown that food in this instance constitutes an important factor in the daily intake and may reach levels approaching whole body burden. Most of the radioactivity is excreted during the first 48 hours. The significance of these findings is discussed. These physiological investigations have concentrated attention upon the mechanisms controlling the retention of radioactive materials in the body. (auth)

6674 A/CONF.15/P/60
SOME SPECIAL PROBLEMS IN HEALTH PHYSICS INSTRUMENTATION. Denis Taylor (Plessey Nucleonics Ltd., Northampton, Eng.). 7p.

The problems of measuring body radioactivity and the monitoring of the liquid and gaseous effluents from reactor plants are discussed. The measurement of body radioactivity can be important in the event of the accidental inhalation, ingestion, or absorption of alpha-active materials. In the case of Pu it is possible to take advantage of the 17-kev x-ray emissions, and the sort of sensitivity which may be achieved for the detection of Pu^{239} by this means and the possibility of producing a worth-while health physics instrument based on this technique are indicated. The measurement of the low activities (α,β,γ) in effluent streams is discussed with an indication of how some of the practical problems encountered in using these methods under factory conditions are solved. (auth)

6675 A/CONF.15/P/99
THE EXPECTATION OF LIFE AND CANCER MORTALITY OF BRITISH RADIOLOGISTS. W. M. Court Brown (Western General Hospital, Edinburgh) and R. Doll (London School of Hygiene and Tropical Medicine). 10p.

The long-term hazard to man of exposure to ionizing radiations may conveniently be studied by epidemiological surveys of suitable human populations. One such population is provided by medical radiologists, since their speciality has now been practiced for over 60 years. A survey was made of the mortality of British radiologists since the founding of the Roentgen Society in 1897. The population studied consists of 1,449 medically qualified members of the British Institute of Radiology, its antecedent Societies, and the more recently established Faculty of Radiologists. The present report relates to the mortality experience of the 1,370 men in this population who had joined one or more of the Societies in or between 1897 and 1954. Of these men, 940 were alive on January 1st, 1955, 424 were known to have died, and 6 were untraced. Each individual was considered to be at risk from the time of joining one of the Societies until the end of 1954 or until he had died (whichever was the earlier), and the numbers of man-years at risk are

summed for each age group and for each of the quinquennia under observation. Estimates of the expected numbers of deaths from all causes, from all forms of cancer, and from certain specific types of cancer were made from these data and from the published mortality rates for England and Wales. Since national mortality data have been published periodically for different socioeconomic classes and for different occupational groups, it was possible to take social status and occupation into account and to compare the numbers of deaths observed with the numbers expected in a population of similar socioeconomic status and among doctors generally. The results were analyzed to see whether they provide any evidence that irradiation in the doses to which the radiologists were exposed might have a nonspecific effect on aging and a general carcinogenic effect. The results obtained suggest that British radiologists have suffered no detectable reduction in their expectation of life and provide no evidence of an increased mortality from any specific type of cancer, other than cancer of the skin. These results contrast with the findings among American radiologists. The possible reasons for this are discussed. It is suggested that the differences may be, in part, methodological, but that they may also be in part due to differences in working conditions and in the standards of protection. It is difficult to assess how far the results can be applied to non-medical occupational exposure, where the energy of the radiation sources is, in general, greater than that of the sources employed in diagnostic radiology. The authors suggest, however, that it is unlikely that under these circumstances also any nonspecific effect on longevity will be detected. (auth)

6676 A/CONF.15/P/10v
THE UPTAKE OF RADIOSTRONTIUM FROM FOODSTUFFS INTO THE MILK OF CATTLE. A. Morgan and G. W. Cox (Atomic Energy Research Establishment, Harwell, Eng.); and R. S. Tayler (Univ. of Reading, Eng.). 11p.

The diet and milk from a herd of cows were analyzed for calcium and strontium-90 at regular intervals for over a year. The relationship between the mean strontium-90/calcium ratio in the diet and that in the corresponding milk was studied, and the discrimination against strontium observed by previous workers verified. The crops contributing most strontium-90 to the diet were identified, and the reasons for the seasonal variation in milk activities were clarified. (auth)

6677 A/CONF.15/P/173
PRINCIPLES FOR DEALING WITH SAFETY AND LOCATION OF ATOMIC ENERGY PLANTS IN SWEDEN. T. Magnusson (Swedish Atomic Energy Board, Stockholm). 6p.

A short account is given of the rules and procedures concerning reactor safety and location embodied in the Swedish Atomic Energy Act of 1956 and in subsequent regulations issued under this Act. A description is given of the administrative machinery for licensing and for the supervision of the licensees. No general rules have so far been formulated for containment and location of reactors and other atomic energy facilities. Every application is dealt with according to the particular characteristics of the project. Consideration is paid to the normal operations of the proposed plant, as well as to the probable consequences of any conceivable accident. After a thorough analysis of the problems concerning the construction and the operation of the plant, an integrated estimate is made of the protective measures and the location of the plant. During this procedure certain conditions are prescribed to be attached to the license. The final specification of these must, however, very often be postponed to a later stage of the construction. Initially, there is only required such information that is considered necessary for an over-all assessment of the project. Some problems that will appear in the case of an accident are dealt with. A study has recently been started of the coordination and the responsibility of different authorities concerned with the consequences of an accident. Proper rules for managing these problems are supposed to be established before the first larger reactor in Sweden is taken into operation. (auth)

6678 A/CONF.15/P/174
BIOLOGICAL INVESTIGATIONS IN THE WATER-RECIPIENT AT STUDSVIK, THE RESEARCH ESTABLISHMENT OF THE SWEDISH ATOMIC ENERGY COMPANY. P.-O. Agnedal, N.-E. Bärring, J. S. Lindhe, and J. W. Smith (AB Atomenergi, Stockholm). 11p.

Radioactive liquid waste from the research establishment at Studsvik will be released in Tvaren, a bay of the Baltic, about 100 km south of Stockholm. Results are presented from a preliminary survey of the biological state of the bay and the activity in water, the sea bed, and various biological objects. Data are tabulated. (C.H.)

6679 A/CONF.15/P/177
STUDIES ON SOIL-PLANT-ANIMAL INTERRELATIONSHIPS WITH RESPECT TO FISSION PRODUCTS. Lars Fredriksson, Bengt Eriksson, et al. (Royal Agricultural Coll., Uppsala). 63p.

Studies on the incorporation of fission products in food-chains have extended over several years. Data are reported from studies on plant uptake of strontium-90 and cesium-137 from soils, plant-animal interrelationships with respect to the absorption of strontium-90, and the transport of long-lived fission products in Swedish soils. (C.H.)

6680 A/CONF.15/P/184
HEALTH AND SAFETY IN CANADIAN OPERATIONS. G. C. Butler, G. Cowper, C. A. Mawson, J. Neil, C. G. Stewart, and G. W. C. Tait (Atomic Energy of Canada Ltd., Chalk River, Ont.). 15p. (AECL-594).

From experience at Atomic Energy of Canada, Limited, it is possible to draw some general conclusions about health and safety in atomic-energy operations. Results of film monitoring and bioassay during 1957 indicate that in general it is possible to handle large amounts of radioactivity without exposing personnel to radiation in excess of 100 mrem/week. Thirteen years ago this would have been considered impossible. A few difficulties remain, however, and these must be overcome by designing and installing improved working facilities and monitoring instruments. In spite of this generally encouraging picture accidental over-exposures may occur at any time. They usually come about in some unforeseen way during what are considered to be normal operations. It is the responsibility of health and safety organizations to reduce the number and severity of these to a minimum. An alert approach to the problem appears necessary, involving constant study and changes in regulations and instrumentation. From five years' investigation of the movement of radioactive wastes through soil and natural waters two conclusions emerge. In multi-curie amounts solid wastes should only be buried with some containment and large vol-

umes of dilute liquid wastes should not be put into the ground indiscriminately. All liquid wastes should be pretreated to prevent increasing the acidity of the soil and then be discharged in such a location that there will be no increase in the flow of ground water through soil containing radioactivity. (auth)

6681 A/CONF.15/P/261
CONTRÔLE CONTINU DE LA PROTECTION CONTRE LES RADIATIONS IONISANTES. (Continuous Control of the Protection Against Ionizing Radiations). Pierre Wenger and Beryl Renard (Inst. du Radium, Geneva). 3p.

For personnel monitoring at the Geneva Institut du Radium film badges are used. The films used are sensitive to doses from 10 mr to 20 r. The film is enclosed between lead foils 1 mm thick containing a central circular hole 1.4 mm in diameter. The photographic density was determined as a function of the radiation. (J.S.R.)

6682 A/CONF.15/P/295
RADIOLOGICAL PROTECTION OF WORKERS ENGAGED IN THE MANUFACTURE OF NATURAL URANIUM FUEL AT THE SPRINGFIELDS' FACTORY OF THE U.K.A.E.A. A. Butterworth, A. Cook, and H. Mason (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). 14p.

The Works manufactures uranium metal from ore concentrates and sheaths it in aluminum and magnesium alloy. Uranium hexafluoride is also manufactured from pile-depleted uranyl nitrate. There are laboratories engaged in physical and chemical research in addition to chemical and metallurgical plants. Processes include solvent extraction of uranyl nitrate, hydrofluorination of uranium dioxide, magnesium reduction of the uranium tetrafluoride so formed, and casting of the metal. Protection must be afforded against solutions, intermediate powders, metal, dusts, and vapors containing alpha, beta, and gamma emitters. An occupational health service ensures that employees are medically suitable on recruitment and that they remain so during employment. A pre-employment medical checkup, including clinical examination, chest x ray, and blood investigation, is compulsory. The subsequent medical categorization specifies the type of work for which the applicant is most suited. These examinations are repeated at a frequency determined by factors such as occupation, radiation exposure, age, and illness. A twenty-four hour casualty service ensures that cases of injury or illness, occurring during the working period, receive adequate treatment. Working conditions are regularly reviewed and advice given to the Works Management when appropriate. Comprehensive medical records are maintained. Employees receive instruction in the principles and practice of radiological protection. The standard of supervision required is high. The beta-gamma radiation emitted by uranium is of a low order, and an average personnel exposure of less than one tenth of the maximum permissible exposure obtains throughout the Works. Employees on casting operations during which UXI and UXII are segregated receive at most about one third of the maximum permissible amount of beta radiation. The relatively high short-term beta exposures that occur in the cleaning and decontamination of the uranium hexafluoride plant do not markedly increase the average beta exposure level. Residual quantities of plutonium and ruthenium, together with UXI and UXII, remain in the reaction vessels, and pressurized suits are worn to prevent inhalation and contamination. Potentially the most serious airborne radioactive dust hazard in the factory arises during this operation. Airborne uranium contamination in most plants is below one tenth of the maximum permissible level. (auth)

6683 A/CONF.15/P/296
SEA DISPOSAL OF LOW ACTIVITY EFFLUENT. P. Bowles, R. H. Burns, F. Hudswell, and R. T. P. Whipple (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 30p.

A proposal was made to discharge mildly radioactive liquid effluent, arising at the new Atomic Energy Establishment at Winfrith Heath, into the sea off the Dorset coast. Experiments are described which were performed at sea from August to November 1956 to determine the rate of sea dilution of a tracer dye by sampling and analysis under varying weather and tidal conditions, to determine significant gradients capable of influencing dilution rates, to obtain data on tidal streams, to sample marine life and deposits from the sea bed, and to study the contour of the sea bed in the area. Results are summarized. (C.H.)

6684 A/CONF.15/P/302
RADIATION EXPOSURE EXPERIENCE IN THE U.K. ATOMIC ENERGY AUTHORITY IN 1957. H. J. Dunster and A. S. McLean (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.), and W. G. Marley (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 11p.

Radiation exposure data for the Industrial and Research Groups during 1957 are summarized. Data are compared with that from previous years, and a decrease in average exposure is noted. (C.H.)

6685 A/CONF.15/P/316
DISTRICT SURVEYS FOLLOWING THE WINDSCALE INCIDENT, OCTOBER 1957. H. J. Dunster, H. Howells, and W. L. Templeton (United Kingdom Atomic Energy Authority, Eng.). 37p.

The sequence of events leading to the reactor accident at the Windscale Works, October 1957, is outlined. The design and location of the reactors are described. Following the accident, milk produced in the area was restricted for human consumption for a period of six weeks. The organization and technical problems involved in the radiological survey of the area are described. (C.H.)

6686 A/CONF.15/P/330
ENSEIGNEMENT TIRE DE L'EXAMEN DES STATISTIQUES ETABLIES A PARTIR DES ARCHIVES RADIOLOGIQUES INDIVIDUELLES. (Lessons Drawn from the Study of Statistics Obtained from Individual Radiological Recording). Henri Jammet and Francois Perrissin (Commissariat à l'Énergie Atomique, Paris). 16p.

The external radiation doses received in France in 1955, 1956, and 1957 professionally by personnel of atomic energy centers, hospitals, universities, and industrial plants are compiled from the measurements of personal film badges monitored every two weeks. Tabulations are made of the total annual dose, the total semi-monthly dose, the total annual and semi-monthly dose received according to the type of work done, and the annual and semi-monthly dose for each of the three years. It is concluded that personnel radiation protection is adequate. (J.S.R.)

6687 A/CONF.15/P/331
DIVERSES EXPRESSIONS POSSIBLES DE LA TOXICITE DES SUBSTANCES RADIOACTIVES EN FONCTION DES PROBLEMES PRATIQUES POSES. (Various Possible Ways to Express the Toxicity of Radioactive Substances in Relation with the Involved Practical Problems.) Henri Jammet and Georges Vacca (Commissariat à l'Énergie Atomique, Paris). 24p.

The toxicity of radioactive substances is difficult to express because of the diverse effects of radiation. Two types of toxicologic classifications are common: one as a function of the weight of the radioelement, the other as a function of the activity. A third classification, the maximum admissible number of nuclei in the organism, is suggested. The number of nuclei is based on H^3 as one. The three classification schemes are compared, a logarithmic expression of relative toxicity analogous to pH is proposed, and the relative toxicity of the principal radioisotopes is tabulated. (J.S.R.)

6688 A/CONF.15/P/553
AIRBORNE RADIOACTIVITY AFTER A REACTOR ACCIDENT. Joh. Blok (National Defence Research Council T.N.O., Rijswijk-ZH, The Netherlands). 8p.

For operation of nuclear reactors in densely populated areas elaborate precautions are necessary. In planning safety measures attention should be given not only to normal operating conditions but also to the procedures to be adopted for an accidental release of radioactive substances. When a radioactive aerosol is created as a result of a reactor accident, it will be very difficult in most instances to predict the extent of surface contamination from meteorological data. A network of air monitoring stations should be in operation to provide the possibility of an alarm at the earliest moment. In the Netherlands airborne radioactivity is sampled on a routine basis at four stations. Membrane filters are used to minimize the self-absorption of soft radiations in the filter paper. In this way the radioactive products originating from the Windscale accident in October 1957 were detected. The presence of Po^{210} could be demonstrated by measurement of the alpha activity. The beta activity contained several short-lived components. One of these components proved to be I^{131}, but nuclides with shorter half lives were also present. The contamination turned out to vary for the four stations in various parts of the country. No simple quantitative relation between the distribution patterns of the various radioactive nuclides could be established. (auth)

6689 A/CONF.15/P/577
HEALTH PHYSICS WORK AND EXPERIENCE IN A SMALL ATOMIC ENERGY ESTABLISHMENT. Gudbrand Jenssen (Joint Establishment for Nuclear Energy Research, Kjeller, Norway). 7p.

The health physics organization, responsibility, and work at the Joint Establishment for Nuclear Energy Research is outlined. Around 200 persons are controlled in addition to monitoring around the reactor, in the laboratories, and surroundings. (auth)

6690 A/CONF.15/P/1106
EXPERIENCE IN RADIOLOGICAL PROTECTION IN SOUTH AFRICA. S. F. Oosthuizen, W. G. Pyne-Mercier, et al. (Union of South Africa). 17p.

Surveys carried out in uranium mines revealed that owing to the low concentration of uranium the external hazard from gamma rays was negligible but that appreciable alpha activity was present. It was established that large quantities and high velocities of ventilating air tend to reduce the alpha activity, while long intake airways, large underground excavations, and series ventilation have the opposite effect. Special attention is consequently paid to ventilation in mines which produce uranium, and a safety code of practice is applicable to all persons regularly employed in uranium plants. Two independent medical surveys, one American and one South African, carried out on the biological findings in a large group of underground uranium mine workers, with regard to lung cancer, gave essentially similar results. These results indicated that, in a sample of approximately 10% of ex-miners dying annually in the period 1947 to 1957, after exposure to the average levels of radon gas in mines, the incidence of primary lung cancer, determined at autopsy, was similar to that obtained in a comparable age group in the general population, that there was no difference in lung cancer incidence between miners and non-miners, and furthermore, that the average age of death was the same for both. Available evidence so far indicates that, as the result of the stringent safety precautions, the radioactivity of the air in South African mines does not represent a serious health hazard. In view of the fact that mining for uranium is now occurring on horizons not previously exploited, future investigation is concerned with determining whether or not the danger from radioactivity has increased. Research into the protective biological response of human skin in the different racial groups exposed to erythematous doses of ionizing radiation to limited skin fields revealed that while hyperplasia and pigmentation of the skin afford protection against the rays of the sun and the dark skinned races enjoyed better protection than the light skinned ones chiefly due to the greater amount of pigmentation in their skins, this same dual reaction, although evident following exposure to erythematous doses of x rays, afforded no protection against x rays and gamma rays and revealed no differences in skin sensitivity in the different color groups. Research on mice with whole-body irradiation by means of lethal doses of x rays and radioactive isotopes followed by bone marrow transplants established a marked measure of protection in that such mice are saved from certain death. This is probably due to a depressed antibody-antigen response. Research will be continued with a view to finding the mechanism of late radiation deaths after initial recovery and the effects of bone-seeking isotopes on the hemopoietic system. (auth)

6691 A/CONF.15/P/1138
DONNEES DE LA SURVEILLANCE ET REGLES QUI EN RESULTENT EN WATIERE DE PROTECTION CONTRE LES RAYONNEMENTS. (Regulations Concerning Radiation Protection and Survey). Duhamel, Lavie, and [L.] Fitoussi (Commissariat à l'Énergie Atomique, Paris). 74p.

A comparative study of the radiation hazards to which the people working in installations of the Commissariat à l'Énergie Atomique are exposed was made and the results reported. The few contamination and irradiation incidents were discussed. Contaminating sources are classified according to the recommendations of the International Commission on Radiologic Protection. The dangers of irradiated elements are discussed. The controls and regulations used for radiation protection are described. (J.S.R.)

6692 A/CONF.15/P/1238
MEASURES ADOPTED IN FRENCH URANIUM MINES

TO ENSURE THE PROTECTION OF PERSONNEL AGAINST THE HAZARDS OF RADIOACTIVITY. INFLUENCE OF RADIOACTIVITY ON THE CONDUCT OF MINING OPERATIONS. (France). 20p.

The personnel of uranium mines must be protected against both external radiation and internal radiation from breathing radioactive dust or air containing radon. The safety precautions taken in French mines to deal efficiently with these dangers are described. The effect of these precautions on the cost of the ore is discussed. (J.S.R.)

6693 A/CONF.15/P/1659
EXPERIENCE IN RADIOLOGICAL PROTECTION MEASURES IN SOME INDIAN MEDICAL INSTITUTIONS. P. V. Hariharan and P. N. Krishnamoorthy (Atomic Energy Establishment, Trombay, India). 10p.

With a view to ensuring radiological hazards control on a countrywide basis, the Atomic Energy Establishment, Trombay, has set up a Radiological Measurements Laboratory. One of the major functions of this Laboratory is the proper control of radiological safety measures in all medical institutions in the country where radiation therapy is used. Radiological protection surveys have been conducted in a number of institutions throughout the country, as part of a countrywide radiological survey program. Some typical results obtained are presented, and the findings of these surveys are discussed. (auth)

6694 A/CONF.15/P/1660
RADIATION DOSE MEASUREMENTS IN THE MONAZITE AREAS OF KERALA STATE IN INDIA. D. S. Bharatwal and G. H. Vaze (Atomic Energy Establishment, Trombay, India). 8p.

This paper presents data collected in two radiation surveys undertaken by the Trombay Establishment of the monazite areas in Kerala State. The radiation dose due to monazite content in the ground is evaluated from theoretical considerations. The methods of measurement including instrumentation techniques and calibration procedures are discussed. A preliminary survey of the monazite area was conducted during the year 1956. This area, 150 miles long and several hundred yards wide, was scanned in about thirty selected towns and at several beach points. The measurements were made with a specially fabricated Geiger Muller type milliroentgen meter. The results indicated radiation levels varying from 3 to 50 times natural background. A second survey which was aimed at investigating the radiation levels inside dwellings in the monazite area was undertaken in the year 1957. A more direct reading type of instrument in the form of a pressurized ionization chamber was used. About 160 residential apartments in 10 different towns in and around the monazite area were investigated. The activity inside any particular house was found to be independent of the type of house and only deciding factor was the activity in the surrounding area. The data obtained was used to determine the average gamma field to which an individual residing in these areas was subjected. The value was found to be about 1300 millirads per year as compared to the natural background of 100 millirads per year. (auth)

6695 A/CONF.15/P/1715
CALCULATIONS RELATING THE ATMOSPHERIC DIFFUSION OF RADIOACTIVE CONTAMINATION FROM THE STACK OF A REACTOR. T. A. Hoffmann and G. Németh (Central Research Inst. for Physics, Budapest). 15p.

A formula for the atmospheric diffusion of contamination was derived taking into account the correct boundary conditions and half lives in the common diffusion problem. The radioactive gases are characterized by the boundary condition that they are not adsorbed at all on the surface, whereas the aerosols are adsorbed on the ground at least in some degree. The solution of the diffusion equation is given with the proper boundary conditions by successive Hankel and Laplace transformations in an analytic form for the case of an impulse-form discharge of contamination from the stack. The concentration value thus obtained is supplied by the factor taking into account the half life and then integrated for a certain discharge of the stack. (auth)

6696 A/CONF.15/P/1953
FISSION PRODUCTS IN THE ATMOSPHERIC PRECIPITATION IN DEBRECEN, HUNGARY, BETWEEN 1952 AND 1957. A. Szalay (Hungarian Academy of Sciences, Budapest) and D. Berényi sen (Lajos Kossuth Scientific Univ., Debrecen, Hungary). 8p.

We measure regularly the fission product conient of the atmospheric precipitations gathered by an ombrometer in Debrecen, East-Hungary, since March 1952. The water is removed once daily from the ombrometer, acidified by HCl, evaporated and concentrated into a glass sample dish of 26 mm diameter and 8 mm deep. After a wait of more than 24 hours for the decay of natural radioactive substances the total β-activity of the sample is measured by means of an end-window G.M. counter of 26 mm diameter. The measured activity is plotted in a histogram versus calendar time in actual counts/minutes and corrected for geometry. The amount of precipitation is also plotted. By measuring the decay of the activity, the date of atomic explosions are determined and identified with known explosions by means of the Way-Wigner formula. In the recent years this has been rendered less reliable by the growing mixed contamination of the atmosphere. A short meteorological evaluation is included. (C.H.)

6697 A/CONF.15/P/1958
FALLOUT MEASUREMENTS IN KRAKOW (CRACOW). L. Jurkiewicz and M. Massalska (Polish Academy of Sciences, Krakow). 6p.

Since February 1957 measurements were made of fall-out activity at Krakow, Poland. Measuring techniques are described. Data are tabulated on the monthly average of activity in rain and dust samples collected in 1957 and 1958. (C.H.)

6698 A/CONF.15/P/2113
KHIMICHESKAYA ZASHCHITA OT IONIZIRUYUSHCHIKH IZLUCHENII. (Chemical Protection Against Ionizing Radiations). B. Chutný, A. Babický, and J. Petrová (Czechoslovakia). 13p.

The protective effect of chemical substances against ionizing radiation in relation to their chemical constitution was studied. A new method of testing the protective effects, based on the experiments of Bacq and Langendorf, was tried with well-known protective substances such as thiourea, cysteine, and cysteamine. The effectiveness of various cysteamine salts were tested. Compounds having the same functional groups as cysteine and cysteamine, but whose carbon skeleton had been enlarged or changed, were synthesized and their effectiveness was tested. The results are tabulated. (J.S.R.)

6699 A/CONF.15/P/2263
THE WORK OF THE INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION (ICRP). Rolf M. Sievert (International Commission on Radiological Protection). 7p.

The International Commission on Radiological Protection and its predecessor, the International X-ray and Radium Protection Commission, have been working on radiation protection problems since 1928. In 1934 the Commission introduced the concept of "maximum permissible dose" which was at that time fixed at 0.2 r per day or 1.2 r per week. In 1950 the Commission lowered this figure to 0.3 r per week. Both these doses referred to persons working occupationally with radiation. During recent years the Commission has extended its field of interest greatly and has now arrived at a certain differentiation of the maximum permissible levels to cover the need of recommendations not only for occupational work but also for persons outside what is called the controlled area and for the population as a whole. The ICRP finds it most appropriate that the Commission limits its work as far as possible to basic recommendations and leaves it to other organizations to use the recommendations for the establishment of codes of practice. The Commission is aware of the many difficulties arising when practical points of view must be taken into account and is therefore ready to co-operate with those bodies deciding upon health and safety regulations. In some cases the Commission has in its recommendations also included data to facilitate the use of its basic recommendations for calculation of doses and will, to a certain extent, extend this work in the next issue of recommendations which will be published in the latter part of 1958. The Commission has gradually increased the scope of its work and broadened the representation in its committees of specialists from most of the relevant fields. (auth)

6700 A/CONF.15/P/2267
ON THE NATURE AND COMPOSITION OF LONG-RANGE FALL-OUT. B. Gross, A. Aron, and E. Meyer (Inst. Nacional de Tecnologia, Rio de Janeiro); F. X. Roser, S. Costa Ribeiro, and A. C. Olinto (Catholic Univ., Rio de Janeiro). 20p.

In the course of routine measurements of particulate air-borne fission radioactivity in Rio de Janeiro, one particularly radioactive filter was found. Closer examination revealed that this filter contained a single active particle of 5×10^{-9} curie. Activity measurements, decay curve, absorption curves, autoradiogram, and a direct enlarged photograph of the particle are given. Volume, active mass, composition, strontium content, and decay scheme were determined. (auth)

6701 A/CONF.15/P/2268
TRENDS OF LONG-RANGE FALLOUT ACTIVITIES IN RIO DE JANEIRO 1956–1958. B. Gross, E. Meyer, and A. Aron (Inst. Nacional de Tecnologia, Rio de Janeiro). 12p.

Results of measurements of fallout activity by the air filter method in Rio de Janeiro over the period May 1956 to March 1958 are given. Several periods of increased activity were observed which could be associated with test explosions of hydrogen bombs in the Pacific proving ground and the Christmas Islands. For a series of filters the decay with time was observed over prolonged periods. The decay curves follow the well-known power law and their analysis permits an approximate determination of the date of the explosion in which the measured activity was released. Generally speaking the observed activity is many times smaller than in the corresponding Northern latitude. In one instance a filter showed a much higher than medium activity. A closer study revealed the presence of a single rather strong ionizing particle produced in one of the British explosions. (auth)

6702 A/CONF.15/P/2269
RADIOSTRONTIUM ANALYSES OF BRAZILIAN STILL-BORN BONES. Eduardo Penna-Franca and Aristides Pinto Coelho (Univ. of Brazil, Rio de Janeiro). 4p.

A series of analyses was made for strontium-90 content of bones from new-born and still-born children from many hospitals of Rio de Janeiro. The analytical method employed consists of separating Sr from Ca by the difference in the solubilities of their nitrates in a 70% nitric acid solution. Radium, a possible contaminating agent, was precipitated from the strontium nitrate salt as barium chromate. The purified Sr-containing solution was kept in deposit for a minimum of two weeks in order that the Sr^{90}-Y^{90} secular equilibrium be attained. The Y^{90} that grew in the stock solution was separated as an oxalate, set up, and counted in a Geiger-Mueller counter with low and stable background. Results are expressed in sunshine units. Data are tabulated. (C.H.)

6703 A/CONF.15/P/2285
RADIOISOTOPES FROM FUSION IN RAIN WATER: Co^{57}, Mn^{54} AND Co^{60}. L. Marquez, N. L. Costa, and I. G. Almeida (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 7p.

The 267-day radioisotope Co^{57} was detected and measured in several rains during one year. The collected rainwater was passed through a cation-exchange column and then eluted with 4N HCl. Cobalt carrier was added to the rain water before passing it through the column. The cobalt was submitted to a thorough radiochemical purification, and the pure cobalt was counted with a single-channel scintillation spectrometer having a sodium iodide well crystal. The spectra corresponded to that of Co^{57} making the identification of the isotope definite. The spectrometer was calibrated for energy measurements and for the efficiency of the gamma rays. (auth)

6704 A/CONF.15/P/2425
INTERNATIONAL ASPECTS OF RADIOACTIVE CONTAMINATION IN WESTERN EUROPE AND THE NECESSITY OF INTERNATIONAL CONTROL ARISING FROM IT. (Royal Netherlands Academy of Sciences.) 6p.

The need for international regulations governing the handling of radioactive materials is discussed. The problem is especially urgent for western Europe because, in addition to great industrial activity and dense population, the area is composed of a number of sovereign states. (C.H.)

6705 A/CONF.15/P/2487
RADIATION PROTECTION IN INDUSTRY–CONTRIBUTION OF THE I. L. O. (International Labour Organization.) 25p.

Policies adopted by the International Labor Organization to assure radiation protection in industry are reviewed. The increasing use of ionizing radiations, both x radiation and radioisotopes, by industry influenced the revision of the Model Code of Safe Regulations for Industrial Establishments. Some of the aspects of the or-

ganization and administration of radiation protection in industry are discussed. (C.H.)

6706 A/CONF.15/P/2518
ATOMIC ICE-BREAKER RADIATION SAFETY SYSTEM. I. V. Sivintzev and B. G. Pologikh (U.S.S.R.). 43p.

A system has been provided for continuous decontamination of the core coolant circuit from radioactive impurities. The ship is provided with a system of general and technological dosimetry which permits immediate detection of radioactive contamination. The paper does not contain any general description of the ice-breaker power plant; it is confined to specific characteristics related to radiation safety. (W.D.M.)

INSTRUMENTS

6707 A/CONF.15/P/121
COMPTEURS GEIGER SANS FENÊTRE À COURANT GAZEUX ET MESURE DE LA RADIOACTIVITÉ D'ÉCHANTILLONS SOLIDES, ÉPAIS, NON CONDUCTEURS DE L'ÉLECTRICITÉ, ÉMETTEURS DE RAYONS β MOUS. (Windowless Flow Geiger Counters do not Correctly Measure the Radioactivity of Thick Non-conductive Solid Specimens Emitting Soft β-Rays.) W. G. Verly, S. Bricteux-Grégoire, et al. (Univ. of Liège). 9p.

It was observed that a windowless flow counter gives erroneous measurements of the activity of thick non-conducting solid samples emitting soft beta rays. The error is augmented if the deposit is placed on a non-conducting support which increases the resistance to the discharge of the static electricity appearing in the sample. This error reaches 5 to 10% for C^{14} in the form of barium carbonate. For tritium counting the error is 50% or more. A conducting deposit gives accurate results, so that C^{14} in such a matrix could be determined, but the self-absorption of the soft beta radiation of tritium makes the technique unserviceable for that element. (J.S.R.)

6708 A/CONF.15/P/216
SOME RECENT APPLICATIONS OF ISOTOPES IN RESEARCH AND CONTROL IN INDUSTRY. J. W. T. Spinks (Univ. of Saskatchewan, Saskatoon, Can.). 24p.

The application of radioisotopes in research and control in industry depends on the detection of the radiations emitted when the isotope decays. The radiations can be used for analysis, both qualitative and quantitative, and in the unique analytical method of isotope dilution. They can also be used to trace materials or things of interest to industry and for the control of industrial processes. Quantitative analytical applications are illustrated by the use of Fe-59, in engine wear studies, to evaluate lubricating oil additives. Tracer studies are illustrated by a description of the use of radioactive fibres to study diffusion and mixing in high-speed paper machines. The use of the isotope-dilution method as a routine analytical procedure for the control of quality of a product such as pentaerythritol in a chemical manufacturing industry will be described, together with its use as a means for controlling the ratio of reactants entering into a chemical process and for measuring the total daily output of a given material. Its application to the study of phase-rule problems of interest to the cement industry will be discussed. An indirect but very important field of application of isotopes in industry depends on the interaction of radiations with matter. Of particular value in the non-destructive testing of matter is the neutron, which can be regarded either as the product of the interaction of radiations from radioisotopes with matter (Ra–α–Be, etc.) or as a radionuclide of atomic number zero. The effectiveness of a medium in producing slow neutrons by the scattering of fast neutrons can be made use of in a variety of instruments for the non-destructive determination of moisture in numerous different materials, such as concrete, moist soil, and mineral pulps. The fractional loss in energy when a neutron collides with an atom is at a maximum for hydrogen, and thus materials with a high moisture content are particularly effective in slowing down neutrons. The activity induced in a slow-neutron detector, such as indium foil or a BF_3 chamber, is independent on the moisture content of the material and can, in fact, be used to measure the moisture content. The scattering of neutrons by matter can also be used to determine liquid levels, in closed vessels, using an instrument located outside the vessel. The application of radiation to automation in industry is discussed. Reference is made to radiation hazards and the precautions to be taken in using isotopes in industry. (auth)

6709 A/CONF.15/P/236
SPECIAL LOW LEVEL COUNTERS. J. Geiss, C. Gfeller, et al. (Univ. of Bern). 7p.

The anticoincidence volume and the counting volume are separated by a foil of adapted thickness or, in the case of very short-range radiation, by thin wires. Three different types of counters were constructed based on this principle: (1) a 1½ liter counter for gas samples of low specific activity (natural C^{14}, tritium) with a background of 0.8 counts per minute; (2) a 5 cm^3 counter for small gas samples of low total activity (spallation products in meteorites) with a background of 0.1 counts per minute; and (3) a 4π counter surrounded by an anticoincidence ring which is separated from the two counting volumes by a thin foil and a background depending on the foil thickness (lower than 0.5 counts per minute). A full description of the performance of the counters is given. (auth)

6710 A/CONF.15/P/248
BASIC REQUIREMENTS FOR CONTINUOUS RADIOACTIVE CONTAMINATION MONITORS. A. Stebler and P. Schranz (Landis & Gyr S. A., Zug, Switzerland). 9p.

An atmosphere monitor is described and illustrated which issues a warning as soon as the product of time and radioactivity concentration reaches a pre-determined level. The instrument consists of a moving filter band with a system of detectors. (C.H.)

6711 A/CONF.15/P/251
LACUNOMETRE: APPAREIL DE MESURE SEMI-AUTOMATIQUE DES LONGUEURS MOYENNES ET DU SPECTRE DES LONGUEURS DE LACUNES DANS LES EMULSIONS NUCLEAIRES. (The Lacunometer: A Device for the Semi-automatic Measurement of the Mean Gap Length Spectrum in Nuclear Emulsions.) R. Weill, C. Joseph, et al. (E.P.U.L., Lausanne, Switzerland). 5p.

A description is given of the lacunometer, a device for the semi-automatic measurement of the mean gap length spectrum in nuclear emulsions. The stage of the microscope is driven by a pick-up motor. A cam moved by this motor produces electric pulses through a set of contacts. The pulses are transmitted by a Morse key to a system which gives the mean value and the differential

spectrum of gap lengths. The use of switching circuits and selectors allows the construction of an apparatus much more simple and stable than those based on electronic devices. If the stage speed is kept at 0.4 μm/sec, the error on mean gap length is 1 to 2% for plateau track and 3 to 4% for a four times greater blob density. (auth)

6712 A/CONF.15/P/294

SIMULTANEOUS HAND AND CLOTHING CHECKING FOR ALPHA AND BETA CONTAMINATION. J. R. Brown (E. M. I. Electronics, Ltd., Hayes, Kent, Eng.). 14p.

A scintillation counter for the detection of alpha and beta particles simultaneously has been realized by the use of a dual phosphor screen for separating the two radiations. This principle has been used in the development of a monitoring instrument which checks the level of alpha and beta contamination of both hands simultaneously in five seconds, the whole operation being fully automatic and proof against misuse. Quantitative indication is given by meters, the final readings remaining until automatically reset when the instrument is used again. Visual and audible indication is given when the acceptable tolerance is exceeded. Alpha and beta-gamma probes are provided for checking clothing. These may be used simultaneously with the hand counters, so that three people may use the instrument at the same time. Circuits, photographs, and technical details of this instrument are given. A typical dual phosphor consists of silver activated zinc sulfide evenly deposited to a thickness of 12 mg/cm^2 and bonded to a block of plastic phosphor. The integral pulse amplitude distribution curve characteristic of the dual phosphor exhibits two distinct plateaux, one corresponding to alpha particles striking the zinc sulfide, and the other to beta particles passing into the plastic phosphor. It can be shown that two fixed thresholds, which depend on the relative response of the two phosphors to alpha and beta particles, exist, the amplitude level of discrimination for beta being lower than that for alpha. If two counting channels are arranged to trigger at different known amplitudes, the photomultiplier output pulses due to beta particles striking the plastic phosphor will cause one channel to trigger but not the other. Output pulses due to alpha particles producing light scintillations in the zinc sulfide will trigger both channels. The triggering of the beta channel by the alpha pulses will not appreciably affect the accuracy of the beta count since the tolerance for alpha radiations is very much less than that for beta radiation at acceptable hazard levels. Thus, by using this method of discrimination, it is possible to monitor alpha and beta contamination simultaneously. (auth)

6713 A/CONF.15/P/329

APPAREILS RECENTS ET METHODES NOUVELLES POUR LA MESURE DE LA CONCENTRATION DES PRODUITS RADIOACTIFS DANS L'ATMOSPHERE. (Recent Instruments for Measuring the Concentration of Radioactive Products in the Atmosphere). C. Jehanno, A. Blanc, C. Lallemant, and G. Roux (Commissariat à l'Énergie Atomique, Paris). 61p.

Radioactive contamination of the atmosphere is a danger which is connected to the development of atomic industry. Six instruments which were developed and constructed in France for the detection of radiation in the vicinity of reactors and nuclear research centers are described. Four of the instruments are designed for measurement of radioactive aerosols, with sensitivities ranging from 10^{-11} to 10^{-1} c/m^3. A special aerosol detector is designed to measure plutonium concentrations. The SP-4 is designed to monitor the radiation produced on the ground by smoke from reactors. The A.D.I.R., an automatic and portable instrument, is designed for measurement of the radon content of the atmosphere. (J.S.R.)

6714 A/CONF.15/P/333

APPAREILS DE MESURE OU DE CONTROLE α, β, γ, n DES CIRCUITS DES USINES DE TRAITEMENT DU MINERAI OU DU COMBUSTIBLE IRRADIE. (Measurement and Control of Radioactivity in Plants for Treatment of Ores and for Treatment of Irradiated Fuel.) A. Blanc, M. Brunet, M. Kermagoret, J. Labeyrie, G. Roux, J. Vasseur, and J. Weill (Commissariat à l'Énergie Atomique, Paris). 46p.

The treatment of irradiated fuel is accompanied by a number of checks of radioactivity to determine the performance of the ion exchangers for uranium recovery, the concentration of plutonium and fission products in the different circuits, and the radioactivity of the effluent discharged into watercourses. The apparatus used for the determination of plutonium traces in the fission product solutions is described in detail. The method used for the control of the extraction of fission products by measurement of the strong gamma activity is discussed. Gamma radiation measurements made in a high gamma background are necessary to verify that no fission products are entrained in the uranium and plutonium solvent phase. The measurement of the neutron flux to control the plutonium concentration in solutions is described. The activity of the effluent is checked by a scintillation counter which controls automatically the α and β radiation emitted by all known fission products. The chemical treatment of ores and the fixation of uranium on exchange resins can be controlled more easily by a determination of the α activity from the uranium than by classical methods. The apparatus used for this purpose is described. A rapid determination is made of the thorium content of complex minerals by a scintillation method which shows the β and α coincidences of ThC and ThC′. The instrument is described. (J.S.R.)

6715 A/CONF.15/P/493

THE ROLE OF IMPURITIES AND THE RADIUS EFFECT IN THE BF_3 PROPORTIONAL COUNTERS. Aleksandar Milojević, Milan Kurepa, and Slobodan Ribnikar (Inst. of Nuclear Sciences "Boris Kidric," Belgrade). 17p.

The influence of impurities on the characteristics of proportional BF_3 counters was studied. Especially the contamination with SiF_4 was investigated, and the results obtained were compared with the characteristics of the counters filled with BF_3 gas, highly purified by thermodiffusion processing. In the study of the properties of proportional BF_3 counters, pulse amplitudes and counting rates as functions of the spatial distribution of the primary ionization were examined. The results were compared with corresponding Ar and Ar + C_2H_5OH proportional counters. Some hypotheses and conclusions about the discharge process are proposed, taking into consideration the "radius effect" and electron capture. The measurements were performed using end window BF_3 proportional counters and a carefully collimated Po α source. (auth)

6716 A/CONF.15/P/554

LOW LEVEL COUNTING OF BETA EMITTERS. G. W.

Barendsen (National Health Research Council T.N.O., Rijswijk-ZH, The Netherlands). 10p.

The factors relevant to the choice of the counting method in order to obtain the best signal-to-noise ratio possible are discussed. The construction of a special counter is described for the measurement of beta radiation of medium and high energy from samples with a very low specific activity. The counter consists of two counters with 60 cm^2 windows facing each other. The samples are mounted between the windows, thereby approximating 4π geometry. (W.D.M.)

6717 A/CONF.15/P/975

CONTROLLED INCREASE OF CONTRAST IN AUTOMATIC PHOTO-SCANNING. A COMPLETED METHOD FOR THE VISUALIZATION OF ORGANS AND TUMORS BY MEANS OF RADIOACTIVE ISOTOPES. C. Winkler (Universitätsklinik, Bonn). 22p.

After detailed studies of scanning methods and after clinical and experimental testing with a conventional scanner, an apparatus was developed for photo-scintigraphy. It is possible to visualize the distribution of gamma-emitting isotopes within the body on an x-ray film whose density is either in a linear or in any serviceable nonlinear dependence on the detected radioactivity. In this way any degree of differences in radiation intensity can be represented at the utmost contrast possible. By means of a special device an anatomically accurate localization of the distribution of isotopes can be achieved, when the film used for photo-scintigraphy is superexposed by an x-ray tube. A series of illustrations shows the results of experimental and clinical studies. This method will diminish the amount of radioisotopes used for diagnostic purposes and thus reduce undesirable radiation exposures. (C.H.)

6718 A/CONF.15/P/977

A NEW DIRECT LOCALIZING AND MEASURING DEVICE FOR EXTENDED RADIATION. K. H. Lauterjung and W. Gruhle (Max-Planck-Inst. Heidelberg, Ger.). 6p.

A new method for localizing and measuring extended radiation, combining the principles of the scintiscanner and closely packed detectors, is described. The area is covered with detectors and their signals are displayed in a time sequence on a CRO screen. (W.D.M.)

6719 A/CONF.15/P/978

KINETICS AND DISTRIBUTION OF 32-P AS MEASURED BY BREMSSTRAHLUNGS INTENSITY IN DIAGNOSTIC AND THERAPEUTIC APPLICATIONS. H. G. Mehl (Freien Univ., Berlin). 16p.

Basic concepts underlying the evaluation of the phosphorus-32 bremsstrahlung for quantitative estimation of deposits of this isotope within the human organism are discussed. The photon spectra of the internal bremsstrahlung and of the external bremsstrahlung as well as the relative yield in photons escaping from the P^{32} accumulated in various tissues have been estimated and are compared on the basis of theoretical and experimental evidence published so far. Photon spectra and the correlation of photon activity with structure and the P^{32} accumulation in various organs have been determined by comparison of in vivo measurements with the results of measurements on phantoms. (auth)

6720 A/CONF.15/P/1101

TRACER TECHNIQUES IN THE FINNISH INDUSTRY. Uolevi A. Luoto and Eric G. Rotkirch (EKONO, Helsinki). 12p.

Since 1954 the use of tracers for industrial investigations has gained a wide interest and has been adopted to solve a great variety of different problems with immediate practical interest. Radioactive tracer methods were first used in Finland to check the wear of blast furnace linings. An extensive study is still under progress. The information so far gained has proved to be of considerable economic value. Several investigations of various types of mixing have been carried out, and quantitative information was obtained on deviations from the desired pattern. Mixing studies were carried out with raw meal basins and silos in the cement industry, bleaching towers and machine chests in sulfite pulp mills, and glass works furnaces. The tests resulted in constructional improvements. (C.H.)

6721 A/CONF.15/P/1144

CELLULE EXPERIMENTALE A EAU SOUS PRESSION. (High Pressure Experimental Water Loop.) M[ichel] Grenon (Commissariat à l'Energie Atomique, Paris) and M. Terny (Société Grenobloise d'Études et d'Applications Hydrauliques, Grenoble, France). 17p.

A high-pressure experimental water loop was constructed for studying the detection and growth of cladding failure in a pressurized reactor. The loop was designed for a maximum temperature of 360°C, a maximum pressure of 160 kg/cm^2, and flow rates up to 5 m^3/hr. The entire loop consists of a main circuit, a continuous purification circuit, a gas recovery circuit, and a low-pressure storage circuit. Each circuit is described. The circuit can be connected to an out-pile apparatus for studying corrosion induction without radiation. It can also be connected to an in-pile apparatus for studying corrosion induction in a high neutron flux. The complete loop is stainless steel. (J.S.R.)

6722 A/CONF.15/P/1163

DISPOSITIFS EXPERIMENTAUX POUR ETUDES EN PILE DU FLUAGE DES MATERIAUX COMBUSTIBLES, ET DU MODULE D'ELASTICITE DES MATERIAUX DE STRUCTURE. (Experimental Apparatus for In-Pile Studies of: Creep of Nuclear Fuels, and Young's Modulus of Structural Materials). A. Gautier, P. LeBret, L. Alfillé, and P. Pesenti (Commissariat à l'Énergie Atomique, Paris). 53p.

Two experimental apparatusus for in-pile study are described. The first is for creep tests under compression of reactor fuels and the second is for the study of Young's modulus of metallic samples during irradiation. In the creep device, three samples are simultaneously tested with identical stress by an elastic membrane deformed under pressure by a carbon dioxide circuit. The length of the specimens is compared to a calibration standard before and after irradiation. The control and safety devices are emphasized. The apparatus for studying radiation effects on Young's modulus is described in detail. The principle used is discussed. (J.S.R.)

6723 A/CONF.15/P/1202

SPECTROMETRE MECANIQUE RAPIDE POUR NEUTRONS INTERMEDIAIRES ASSOCIE A LA PILE EL_3. (Intermediate Energy Neutron Fast Chopper Associated to the Pile EL 3.) Jean Julien, Francis Netter, Roger Martin, and Pierre Rouge (Commissariat à l'Energie Atomique, Saclay, France); René Arditti and Pierre Chaffiotte (Société d'Exploitation des Matériels Hispano-Suiza, France). 16p.

The design and operation of a fast chopper for time-of-flight measurements of intermediate-energy neutrons are presented in detail. In principle, the chopper

is modeled after the Brookhaven spectrometers. The unique characteristic of the spectrometer is the drive system of the rotor which uses an oil turbine. (J.S.R.)

6724 A/CONF.15/P/1207
NOUVELLE METHODE DE MESURE DES FLUX DE NEUTRONS DANS LES REACTEURS ATOMIQUES. (A New Detector for the Measurement of Neutron Flux in Nuclear Reactors.) Lydie Koch, Jacques Labeyrie, and Serge Tarassenko (Commissariat à l'Énergie Atomique, Paris). 16p.

The detector described is designed for the instantaneous measurement of thermal neutron fluxes, in the presence of high γ activity; this detector can withstand temperatures as high as 500°C. It is based on the principle that radioactive atoms resulting from heavy-nucleus fission in the detector are carried by a gas flow to a detector recording their β and γ desintegration. Thermal neutron fluxes as low as few neutrons per cm^2 per second can be measured. This detector may be used to control a nuclear reactor and to plot the thermal flux distribution with an excellent definition (1 mm^3) for fluxes higher than $10^8 n/cm^2/sec$. The time response of the system to a sharp variation of flux is limited, in the case of large fluxes, to the transit time of the gas flow between the fission product emitter and the detector; of the order of one tenth of a sec per meter of piping. The detector may also be used for spectroscopy of fission products older than 0.1 sec. (auth)

6725 A/CONF.15/P/1208
QUELQUES REMARQUES SUR LA MESURE ABSOLUE DES EMETTEURS β AU COMPTEUR 4 π. (Some Remarks Concerning the Absolute Measurement of β Emitters by the 4 π Counter.) B. Grinberg and Y. Le Gallic (Commissariat à l'Énergie Atomique, Paris). 11p.

The precision obtainable with a proportional or Geiger-Mueller 4 π counter in the determination of radioactivities depends on the precision with which the various corrections are evaluated. One of the most important corrections is the correction for absorption in the film serving as support for the source. To determine conditions in which the absorption could be maintained at a negligible level, a study was made with a 4π Geiger-Mueller tube. The performance of the tube using very thin films was determined. Film thicknesses of 5 $\mu g/cm^2$ were obtained, and such films made it possible to eliminate completely the absorption correction for energies higher than 0.3 Mev. For energies lower than 0.3 Mev, the addition of a coincidence amplifier with resolution time slightly higher than the average "transport" time of the particles eliminates the need for absorption corrections. (J.S.R.)

6726 A/CONF.15/P/1209
ETAT ACTUEL DU DEVELOPPEMENT DES COMPTEURS A SCINTILLATION EN FRANCE. (Present State of Scintillation Counters Development in France.) Y. Koechlin, L. Koch, and A. Lansiart (Commissariat à l'Énergie Atomique, Paris), and G. Pietri (Laboratoire d'Electronique et de Physique Appliquées, France). 36p.

The industrial production of photomultipliers and scintillators has increased steadily in France in the last few years. The general performance of the industrial detectors and the present status of new developments are given. (J.S.R.)

6727 A/CONF.15/P/1210
REALISATIONS FRANCAISES DANS LE DOMAINE DE L'ELECTRONIQUE NUCLEAIRE. (French Accomplishments in the Field of Nuclear Electronics.) M. Doireau, R. Fabre, H. Guillon, and C. Guyot (Commissariat à l'Énergie Atomique, Paris). 47p.

The steps taken by the Commissariat à l'Énergie Atomique to encourage the industrial production of the electronic devices needed in nuclear research are described. The criteria established for the acceptance of electronic equipment are discussed. (J.S.R.)

6728 A/CONF.15/P/1211
CONTRIBUTION A LA DETECTION DES RAYONNEMENTS EN VUE DU CONTROLE ET DE LA PROTECTION. (Radiation Detection for Control and Protection.) Fuhrmann, [H]. Joffre, and Savouyaud (Commissariat à l'Énergie Atomique, Paris). 11p.

The improvements made in the fields of gamma-ray dosimetry by photographic films, alpha dosimetry and spectrometry, standardization and autonomy of the electronic components of radiation detectors, and the dosimetry of pulsed radiations are described. The sensitivity of film to x rays and chemical reagents was studied so that a correction could be applied to gamma film dosimetry for these factors. Research on alpha dosimetry led to the improvement of ZnS scintillation counting. The construction of an alpha spectrometer is described. A description is given of improvements made in ionization chambers, counters, and scintillators. The measurement of pulsed radiation of very short periods is discussed. (J.S.R.)

6729 A/CONF.15/P/1273
LE FROTTEMENT DU CARBONE DANS LES GAZ SECS. (Friction of Carbon in Dry Gases.) J. Millet and J. Parisot (Société le Carbone-Lorraine, Paris). 4p.

The operation of rotating machines at high altitudes and of motion-transmitting devices in reactors is made difficult by the high wear and friction of sliding surfaces in a dry atmosphere. The friction of different grades of carbon on metals and on carbon itself was studied in dry atmospheres of oxygen, nitrogen, and carbon dioxide and in a humid atmosphere. The chemically or physically active gases, oxygen, carbon dioxide, and water, affect the wear and friction more than nitrogen. Friction and wear of carbon is related to the properties of gas adsorption. (J.S.R.)

6730 A/CONF.15/P/1281
CONCERNING THE USE OF SPARK COUNTERS FOR THE DETECTION OF FAST NEUTRONS. M. Nachman, L. Schlichter, and H. Totia (Inst. for Atomic Physics, Bucharest). 10p.

A study of the possibility of using the Chang and Rosenblum spark counter for the detection of alpha particles and the detection of fast neutrons is presented. The optimum operating conditions of the spark counters were determined. The counters were filled with nitrogen, hydrogen, or air. (W.D.M.)

6731 A/CONF.15/P/1340
THE PREPARATION OF TEST CHART TO BE USED FOR MEASURING RESOLVING POWER OF NUCLEAR EMULSION. Shumpei Oka, Takashi Mukaibo, Shin Suzuki, and Keiichi Yamada (Tokyo Univ.). 41p.

Stevens' autoradiographic method for the evaluation of the resolving power of nuclear emulsions using I^{131} (Brit. J. Radiol. 23, 723-30(1950)) was extended to pre-

pare test charts for S^{35} and P^{32}. The method of preparation of the test chart for S^{35} is described and the experimental results obtained are discussed. The factors in the preparation and testing of the test chart which affect its resolution power are analyzed. The preparation of a similar chart for P^{32} is described. (J.S.R.)

6732 A/CONF.15/P/1348
PROCESS ANALYSIS BY RADIOISOTOPES IN THE CHEMICAL AND METALLURGICAL INDUSTRIES. Tatsuo Saito (Showa Denko Kabushiki Kaisha, Tokyo). 30p.

Applications of radioisotopes in process analysis in the chemical and metallurgical industries are reviewed. Applications discussed include studies in electrolysis of chlorine caustic; analysis of the flow pattern of electrolyte in the potassium chlorate cell; process analysis in an alumina plant, studies on the flow of glass in melting and working furnaces; the behavior of sulfur in butyl rubber; measurement of the residence time of ore pulp in flotation cells, determination of gas transit time in a blast furnace, measurement of the flow of molten metal in a copper refractory furnace, and measurement of the iron-tin alloy layer of tinplate. (C.H.)

6733 A/CONF.15/P/1349
RECENT DEVELOPMENT OF INDUSTRIAL MEASURING EQUIPMENTS IN JAPAN. Kenichi Owaki, Tadasmi Oshida, Hirohide Miwa (Kobe Kogyo Corp., Japan). 29p.

Applications are described of radioisotopes in industrial measuring equipment. Thickness gages employing beta emitters and level gages employing cobalt-60 and cesium-137 gamma sources are described. Applications in various industries are reviewed briefly. (C.H.)

6734 A/CONF.15/P/1358
U-SCOPE, AN ELECTRONIC LOCATOR OF RADIOACTIVE SOURCES APPLYING THE PRINCIPLE OF RADAR. Kikuo Takahashi, Nobuo Katayama, and Moto-o Sato (Japan). 12p.

The U-Scope, a device for the rapid detection of radioactive sources in a field survey, is constructed of a rotating collimator or scanner and a radar tube on which complete information concerning the direction and occurrences of the radioactive sources is given. The collimator and the electronic system are discussed in detail. Typical images are given and analyzed. A field survey made in Okayama and Tottori Prefectures proved the value of the instruments. (J.S.R.)

6735 A/CONF.15/P/1369
REMARKS ABOUT GAS BUBBLE CHAMBER CHARACTERISTICS. P. E. Argan, A. Gigli, E. Picasso, G. Tomasini, and L. Gonella (Istituto Nazionale di Fisica Nucleare, Genoa; Istituto Nazionale di Fisica Nucleare, Turin; and Univ. of Genoa). 7p.

The effect of ionizing radiation on strongly supersaturated gas–liquid solutions has been observed by the Genoa research group during the Spring of 1956. The group established, in a first approximation, the conditions which the gas–liquid systems must satisfy in order to turn this effect into formation of bubble tracks along the ionizing path. Some of the results recently obtained by various groups working at the same type of research, with the emphasis on results obtained in Genoa during last year are given. Included are general characteristics of the gas bubble chambers for various gas–liquid mixtures, such as pressures and work temperatures, sensitivity and sensitivity time, and cycling time and efficiency. In addition, the behavior of many component systems under the action of ionizing particles as a function of the parameters characterizing their thermodynamic state, with emphasis on the nucleation processes and dynamics of bubble growth are examined. Finally, the characteristics of the gas bubble chamber of a special type such as component mixtures with a high content of hydrogen, and mixtures of components with high atomic number, are considered. (auth)

6736 A/CONF.15/P/1370
DISTORTION OF TRACKS IN BUBBLE CHAMBER. P. Bassi, R. Cano, S. Focardi, A. Michelini, and F. Saporetti (Univ. of Bologna). 4p.

The distortions in liquid hydrogen bubble chamber pictures and the methods to reduce such distortions are discussed. The chamber under construction at Bologna is described. (auth)

6737 A/CONF.15/P/1409
RESPONSE OF ORGANIC SCINTILLATION DETECTORS TO VARIOUS PARTICLES. M. A. Vigón, J. Montes, C. E. Granados, and R. G. Bernal (Junta De Energía Nuclear, Madrid). 7p.

The response of organic scintillation counter crystals to charged particles has been studied for the higher energies. On the other hand, the data bearing on the energies inferior to 2 Mev are scant, and this is the range in which the response curve departs most markedly from linearity. The results obtained with protons and deuterons for energies ranging from 0.2 to 2 Mev are given. A bundle of protons or deuterons passed through a very thin diaphragm before reaching the deflection chamber. The detector was exposed directly to the bundle at a 25° angle and at a 3 m distance from the deflection chamber. The accuracy in the measurement of the energy was ±20 kev. A study was made of the response to monoenergetic neutrons correcting the experimental data with the results previously obtained for the protons. (auth)

6738 A/CONF.15/P/1435
A RECORDING METHOD FOR WATER LEVEL FLUCTUATIONS BASED ON GAMMA RAY ABSORPTION. P. Weinzierl (Univ. of Vienna) and A. Mayerhofer (Federal Hydraulics Research Inst., Vienna). 9p.

An instrument is described for the measurement of fluctuations of water levels, based on the absorption of low energy γ radiation. A Tm^{170} source (50 to 100 mc) is surrounded by a lead shield with collimator and submerged entirely below the water surface. Between the collimator and the detector an adjustable free space exists depending on the amplitude of level fluctuations. At minimum water level at least 5 mm of water covers the source container. The bar connecting source holder and detector lead passes the water surface at a position 20 cm apart from the point of measurement. The γ-ray intensity reaching the NaI scintillation detector varies with the height of the water level above the source. (W.L.H.)

6739 A/CONF.15/P/1465
PHOTOMULTIPLIER TUBES AND SCINTILLATION COUNTERS. J. Sharpe and E. E. Thomson (E.M.I. Electronics Ltd., Ruislip, Middx., Eng.). 26p.

An account is given of the photomultiplier tube considered as a component of a scintillation counter. Possible compromises among the disposable parameters

are indicated to obtain the best performance for particular task. The required characteristics are explained which may be correlated with data obtained by methods of test not directly related to scintillation counter techniques. (W.D.M.)

6740 A/CONF.15/P/1473
A CONTINUOUSLY OPERATED INSTRUMENT FOR THE STEPWISE MEASUREMENT OF THE RADIOACTIVITY OF GAS SOLS WITH A SPECIAL BACKGROUND COMPENSATION. J. H. Spaa (N. V. Philips' Gloeilampenfabrieken, Eindhoven, The Netherlands). 13p.

The instrument uses a roll of filter paper moving stepwise between an exit tube and an opposing inlet tube, provided with a rubber ring. During a measuring period the inlet tube presses down the filter paper on a metal support connected to the exit, thus forming a gas tight joint. During transport the inlet tube is raised and the pump stopped. An alpha ray detector is mounted in the entry immediately above the paper, while underneath a beta counter is arranged. Each detector is connected to a count-rate meter. (auth)

6741 A/CONF.15/P/1627
A XENON POISON COMPUTER. M. M. L. Gulati, V. Mahajan, A. W. Pereira, and J. Ranganath (Atomic Energy Establishment, Trombay, India). 14p.

In this computer, the variations of reactor power are recorded by a strip chart recorder, using conducting ink. On the occurrence of a shutdown, the chart is fed to an automatic curve follower, having a chart speed much higher than that at which the chart was recorded. The curve follower output, which is proportional to the recorded power variations, is used as the driving function of an electronic analog computer operating on an accelerated time scale and synchronized with the curve follower, and this computes the iodine-135 and xenon-135 concentrations as a function of time, up to the moment of shutdown. The computer time scale is then further accelerated, and using the iodine and xenon concentrations previously computed as initial conditions, the buildup and decay of xenon after shutdown is calculated. The results are presented as a curve of reactivity absorbed by the poison against time. (auth)

6742 A/CONF.15/P/1643
A NEW METHOD FOR THE ESTIMATION OF RADON AND THORON CONTAMINATION IN AIR AND ITS APPLICATIONS. K. G. Vohra (Atomic Energy Establishment, Trombay, India). 14p.

An instrument depending upon the collection of charged ions for the estimation of thoron and its daughter products in air is described. The positively charged ions of the decay products of thoron from a known volume of air are collected on a metal disk by the application of a suitable electric field. The alpha activity of the collected samples is measured with a scintillation counter. A comparison is made of the methods of collection of dust on filter papers and ion collection for the estimation of thoron levels. Absolute estimation of thoron levels is possible by the ion collection method whereas in dust collection there is no certainty about the size of dust to which the daughter products of thoron are attached. The instrument was used for a survey of thoron levels in a plant for the production of thorium nitrate. (auth)

6743 A/CONF.15/P/1667
DEVELOPMENT OF SOME INSTRUMENTAL DEVICES FOR RADIOASSAY OF CORE SAMPLES AND PROSPECTING FOR RADIOACTIVE MINERALS, ET CETERA. A. S. Bhatnagar (Dept. of Atomic Energy, India). 13p.

For rapid assaying of a large number of drill cores, a core assayer was developed which enables the entire operation to be carried out automatically, the U_3O_8 content of the core samples being also automatically recorded on a graph. About a hundred feet of core can be assayed per day. An instrument was developed which automatically traces the plateau of a G-M tube as a graph. One trace with fair detail can be obtained in a minute saving considerable time. Particulars of the working of the machine are described. A method of discriminating uranium and thorium in aerial surveys is described. (auth)

6744 A/CONF.15/P/1681
MESURE DE LA DENSITE EN NEUTRONS THERMIQUES D'UN MILIEU UNIFORME AU MOYEN DES EMULSIONS NUCLEAIRES CHARGEES AU BORE. (The Use of Boron Charged Nuclear Emulsions for Measuring Thermal Neutron Densities in a Uniform Medium.) C. Beets, H. Breny, and J. Fournaux (Centre d'Etude de l'Energie Nucléaire, Brussels). 15p.

A photographic technique for the counting of tracks is presented which gives a definition of the limits of a constant-volume cell and information on the distribution in depth of the charge element. It also provides for an investigation of the homogeneity of the boron distribution in the emulsion. A method is given for the determination of boron and for an analysis of the correlation between the boron and nitrogen in the emulsion. Some measurements made with this method are used as illustration. The technique practically eliminates the variation caused by the emulsion thickness and reduces the effect of the material and the observer error. (J.S.R.)

6745 A/CONF.15/P/1682
DETECTEURS DE FAIBLE ACTIVITE D'EMETTEURS DE RAYONNEMENT ALPHA—APPLICATION DE CES DETECTEURS A LA MESURE DE LA CONTAMINATION DES EAUX, AEROSOLS ET SURFACE DE TRAVAIL. (Low Level Alpha Detectors and Their Use for the Measurement of the Contamination in Water, Aerosols and on Working Surfaces.) R. Boulenger and E. Gourski (Centre d'Etude de l'Energie Nucléaire, Brussels). 18p.

To measure the alpha activity levels lower than the maximum permissible level for contamination in air, water, and on surfaces that can come in contact with the skin, three types of alpha detectors were constructed and their performance studied. The types studied were proportional counter filled with air, proportional counter filled with methane or argon—methane mixture, and scintillation counter with zinc sulfide. A scintillation counter with a window for measurement of samples and a scintillation counter with window for use as a monitor were built. (J.S.R.)

6746 A/CONF.15/P/1685
NEW POSSIBILITIES IN THE REALM OF SLOW NEUTRON SCINTILLATORS. G. Thielens (Univ. of Ghent). 5p.

The behavior of luminescent organic boron compounds as scintillators and the properties of homogeneous mixtures of an organic scintillator with partially dehydrated or non-dehydrated boric acid were studied. Compounds of α-naphthaleneboric acid, 9-phenanthreneboric acid, tri-α-naphthylboron, and α-naphthaleneboric oxide were prepared and tested. In each of these compounds the fluorescence spectrum has a maximum in

the region of 500 mμ which permits the use of a standard photomultiplier. The α-naphthaleneboric acid showed excellent properties as a slow neutron scintillator. (W.D.M.)

6747 A/CONF.15/P/1973
SATELLITE PEAKS IN THE BETA SPECTROMETERS OF THE KOFOED-HANSEN TYPE. L. Lagatta, C. A. Mallmann, C. Molinay Vedia, J. Peyre, and J. Suarez Etchepare (Comisión Nacional de Energía Atómica, Buenos Aires). 11p.

A monoenergetic source will give, in addition to the main peak, other less intense but broader peaks which are called satellites. Experimental verification of this effect is described using an instrument having 8 gaps. The possibility of ruling these peaks out is discussed. (W.D.M.)

6748 A/CONF.15/P/1974
OPTICS OF BETA SPECTROSCOPES OF THE KOFOED-HANSEN TYPE WITH n LOOPS TRAJECTORY. José F. Suárez Etchepare (Comisión Nacional de Energía Atómica, Buenos Aires). 14p.

The advantages of the instruments in which $|n_x|>0$ are well known, from the standpoint of the resolving power. The gathering power remains limited, for the small apertures, because the trajectories come out of the magnetic field. Graphs are given for the purpose of computing the efficiency of large sources, allowing for the losses due to trajectory rotation. The spectrum of a monochromatic source presents, in addition to the base peak, others which have a broad base but are not high, and which might vitiate the results when continuous background investigations are made. (auth)

6949 A/CONF.15/P/2041
REVIEW OF PULSED NEUTRON SOURCES FOR NEUTRON SPECTROMETERS. V. V. Vladimirskii (Vladimirsky) and V. V. Sokolovskii (Sokolovsky) (U.S.S.R.) 29p.

The description of some new designs of mechanical choppers for use in reactors is presented together with a comparison of their characteristics. A brief description of a thermal neutron monochromator with increased aperture is given. New results are reported concerning the methods of obtaining the short neutron pulses in a cyclotron by means of deflection of the beam onto an internal target. Methods of increasing of neutron spectrometer resolving power are discussed. (auth)

6750 A/CONF.15/P/2083
AN INSTRUMENT FOR MEASURING LOW FLUXES OF HIGH-ENERGY NEUTRONS. P. S. Baranov, V. I. Goldanskii, and V. S. Roganov (Academy of Sciences, U.S.S.R.). 7p.

An instrument employed for measuring low fluxes of neutrons with energies above 20 Mev is described. The instrument is very simple from the point of view of construction and handling. It is based on the activation of carbon in liquid organic scintillators by a measured neutron flux according to the reaction $C^{12}(n,2n)C^{11}$, and on the subsequent measurement of C^{11} activity by means of photomultiplier tubes. (W.D.M.)

6751 A/CONF.15/P/2084
BORON IONIZATION CHAMBERS FOR WORK IN NUCLEAR REACTORS. A. B. Dmitriev (U.S.S.R.). 9p.

Boron ionization chambers are used in nuclear reactor control and protective systems to measure the intensity of slow neutron fluxes. The ionization current in the chamber resulting from the $B^{10}(n,\alpha)Li^7$ reaction is the measure of the neutron flux intensity. The various instruments described fall into two groups: working chambers serving to control reactors within the nominal power measurement range and triggering chambers operating as the reactor power rises from zero to nominal. (W.D.M.)

6752 A/CONF.15/P/2087
SISTEMA RADIOMETRICHESKIKH IZMERENII PRI RABOTE S RADIOAKTIVNYMI IZOTOPAMI. (The System of Radiometric Measurements in the Application of Radioactive Isotopes. K. K. Aglintsev, M. A. Bak, V. V. Bochkarev, E. G. Gracheva, E. V. Ershova, and K. A. Petrzhak (U.S.S.R.) 17p.

A system of radiometric measurements used when dealing with radioisotopes is described. The system is based on the following: unification of measurement units; the setting up of standards, standard methods, and standard devices reproducing the size of the units; the setting up of model measurements and measurement devices; the development of methods for controlling the preparation; and the calibration of measurement devices. The basic requirements to standardize alpha, beta, gamma, and neutron sources are formulated, and recommendations are made on the selection of isotopes in the preparation of standard sources. Special consideration is given to the measurement of small activities corresponding to the isotopic maximum permissible concentration in water and air. (J.S.R.)

6753 A/CONF.15/P/2103
COMPLETE AUTOMATION OF NUCLEAR REACTOR CONTROLS BY MEANS OF AN AUTOMATICALLY MOVED DETECTOR. P. Kovanic and M. Kulka (Czechoslovakia). 17p.

An analysis is made of the properties of the safety and signalization circuits of reactors, based on the use of a detector automatically moved so, as to be always in a position, where there is a constant neutron flux, irrespective of the immediate power of the reactor. Such circuits may consist of simple elements and may by themselves check their own correct functioning. The properties of the control systems based on the principle of the automatic control of the reactor power according to the movement of the detector are examined. Systems are designed for the automatic starting of the reactor from subcritical state, for reaching the predetermined power by the chosen period, and for the control of the power. Compact schemes of automatic reactor control may be obtained by supplementing this equipment by independent signalization circuits with an automatically transferred detector. (auth)

6754 A/CONF.15/P/2108
MEASUREMENT OF ABSOLUTE DOSES OF GAMMA-RADIATION WITH METALLIC IONIZATION CHAMBERS. Joseph Klumpar (Czechoslovakia). 8p.

An investigation was made of the influence of wall material, wall thickness, and ionization volume of cylindrical ionization chambers exposed to known doses of gamma radiation in the range 84 to 1600 kv on the ionization current per unit of volume. The results of the measurements show the increasing influence of a higher atomic number of the wall material on the increase of the ionization current, especially in the range of low energies of gamma radiation. The experimental figures further show a distinct influence of the ionization volume with a maximum in the range

of 3 cm^3. This effect is explained when the spectrum of the secondary electrons originating in the wall and the higher linear density of ions on the tracks of the electrons in air are considered. (auth)

6755 A/CONF.15/P/2110
A REPRODUCIBLE CHEMICAL DOSIMETER FOR MEASUREMENT OF LOW DOSES OF GAMMA AND X RAYS. Z. Spurný (Czechoslovakia). 8p.

A solution of resazurin in 96% alcohol in the mixture of carbon tetrachloride with absolute alcohol represents a single phase chemical dosimeter. The applied dose can be determined by visual comparison to a color standard with an accuracy of 15% or a higher one (± 5 per cent) by the measurement of pH of water added. Characteristics of this dosimeter were investigated. No special measures are required and the solution holds stable a few days in ground brown ampules. For a long stability the dosimeter system must be prepared in the absence of CO_2 and sealed in brown flasks. (auth)

6756 A/CONF.15/P/2188
TIME ANALYZERS FOR NEUTRON SPECTROSCOPY. A. P. Tsitovich (U.S.S.R.). 32p.

A review is presented of research work conducted in various institutes of the USSR Academy of Sciences on the development of time analyzers for neutron spectroscopy of the time-of-flight type. Basic requirements for time analyzers and the means of their achievement are considered. Diagrams of new matrix analyzers are shown. Instruments with memory devices on ordinary cathode-ray tubes and potentiometers are described. Various systems on magnetic drums with channels from a few hundred up to a few thousand are compared; devices of intermediate memory operating with such systems are also described. Some information on two time analyzers with ferrite memory on 512 channels and on 1024 channels with a double intermediate memory is given. (auth)

6757 A/CONF.15/P/2205
DETERMINATION OF GASEOUS IMPURITIES IN STRUCTURAL AND OTHER MATERIALS. Z. M. Turovtseva and N. F. Litvinova (U.S.S.R.). 33p.

Small quantities of gaseous impurities in certain structural materials are very difficult to determine. The most universal methods for this purpose are various versions of the vacuum-melting method, the success of which depends greatly on the equipment used. An apparatus has been designed and built which enables the gaseous impurities in a large number of metals to be determined. The design of this apparatus is very simple owing to the use of only one high-vacuum pump which serves both for delivering the gases liberated from the specimen to the analysis space and for evacuating the entire vacuum system. The use of a palladium filter for hydrogen determination makes it possible to avoid circulation systems and greatly simplify the design and reduce the time required for analysis. The apparatus is also provided with a system for sampling the specimens to be analyzed and transferring them to the crucible out of contact with the air. The simplest version of the vacuum-melting method is employed for determining gases in copper, silver, boron, and platinum. (auth)

6758 A/CONF.15/P/2232
THE THEORY AND PRACTICE OF RELAY TYPE INSTRUMENTS BASED ON RADIOACTIVE ISOTOPES. N. N. Shumilovskii (Shumilovsky), V. A. Yanushkovskii, (Yanushkovsky), and I. M. Taksar (U.S.S.R.). 29p.

A number of problems in the technique of automatic control and regulation of production processes can be solved by means of relay-type instruments incorporating radioactive isotopes. The operation of instruments of this type is based not on changes in the intensity of radioactive radiation but on the recording of its presence or absence. With relay-type apparatus it is possible to have a recording equipment made of uniform and standard units in which gaseous discharge counters are used. This simplifies greatly the electric circuit of the equipment and makes it less expensive. Standard units of recording devices can be used in various industries for different technical applications. Basic schemes for instruments of the relay-type are suggested, which can be used to solve a wide range of position control problems. (auth)

6759 A/CONF.15/P/2333
MICROCAPILLARY TECHNIQUES FOR THE INCORPORATION OF NUCLEAR TARGETS IN THE MASS PHOTOGRAPHIC EMULSIONS. J. Catalá, J. Casanova, and V. Domingo (Univ. de Valencia and Junta de Energía Nuclear, Madrid). 14p.

Techniques are described for the preparation of nuclear emulsions loaded with various elements incorporated as reaction targets. To facilitate microscopic examination of the emulsions, the elements were incorporated in the form of metallic wires, impregnated plastic wires, or silk threads. This method permitted a search for the events along such wires, greatly facilitating observation. A variation of this technique was developed for a study of ordinary fission and of ternary fission of uranium-235 when bombarded by thermal neutrons in the thermal column of an atomic reactor. This variation consisted of incorporating into the emulsion a series of microcapillary glass tubes filled with the target substance completely isolated from the emulsion. A method is described for preparing and filling the microcapillaries. A schematic sketch of the small refractory furnace used is included. Results are reported from an investigation of the stopping power of glass and a computation of the energy field of the particles emitted inside the tube. Applications are reported in investigations of the alpha radioactivity of natural elements, the ternary fission of uranium-235 when bombarded with thermal neutrons, and irradiations with bremsstrahlung from tubes filled with mercury producing the relevant photoreactions. (C.H.)

6760 A/CONF.15/P/2334
CHARACTERISTICS OF DUMONT 6292 PHOTOMULTIPLIER TUBES. Rafael Gaeta and Francisco Manero (Junta de Energía Nuclear, Madrid). 10p.

The variation of resolution of Dumont 6292 photomultiplier tubes versus voltage applied to the dynodes was studied. It was found that if the voltage between photocathode and first dynode is held constant and the voltage between dynodes 1 and 10 is changed slightly there is no measurable variation in the resolution but pulse height changes accordingly with voltage variations. (W.D.M.)

6761 A/CONF.15/P/2343
COMPACT LOW-LEVEL COUNTING ARRANGEMENT. K. van Duuren, W. K. Hofker, and J. Hermsen (Philips' Research Labs., Amsterdam). 17p.

The contribution of mesons to the background of a beta counter is customarily eliminated by means of a ring of anticoincidence counters. The application of a counter tube with hollow anode, instead of a ring of

Geiger counters, gives the possibility of an anticoincidence arrangement of much simpler and more compact design. A beta counter is placed inside the hollow anode of the guard counter in such a way that all mesons that strike the beta counter have crossed the gas volume of the hollow anode counter. All coincident pulses are eliminated with an anticoincidence circuit. As only two counters are used, the complete electrical circuitry will be very simple. Due to the compact shape of this anticoincidence arrangement a considerable saving of weight for the shielding can be achieved. Background measurements were done for an end-window halogen-quenched beta counter. By a proper choice of materials and dimensions of this counter a considerably lower background counting rate for the beta counter than for the equivalent Philips' counter tube 18505 could be obtained. In an anticoincidence arrangement with a shield of 20 cm iron and 2.5 cm mercury the residual background amounted to 0.7 to 0.9 counts/min. The counting properties of the guard counter and the beta counter were investigated. (auth)

6762 A/CONF.15/P/2347

A SUITABLE TRITIUM CARRIER FOR GAS DISCHARGE TUBES. O. Reifenschweiler (Philips' Research Labs., Eindhoven, Netherlands). 7p.

The application, especially in manufacturing processes, of radium and similar radioactive materials as priming agents in gas discharge tubes is very undesirable owing to the danger to health which they involve. To avoid this danger or to diminish it as much as possible, various attempts were made to employ tritium as a priming agent. This radioactive gas is especially suitable for this purpose because of its extremely soft beta radiation, the absence of hard gamma radiation, its high specific activity at a relatively low price, and above all its extremely high maximum permissible concentration in comparison with radium. To avoid the handling of gaseous tritium, which is undesirable in manufacturing processes, the tritium is applied in a suspension of a tritiated titanium powder. On account of the small energy of the beta particles the grains of this titanium powder have to be extremely small. A powder prepared by careful milling and elutriation with grains of about 1 μ proved to be much too coarse. Only a few percent of the beta particles of the tritium then leave the titanium grains. However, by evaporation of titanium in an atmosphere of rare gases, a powder with a grain diameter of about 300 A is obtained. After absorption of the tritium by this titanium powder a suspension in an organic fluid is prepared by ultrasonic treatment. The electron-emitter surface is then very conveniently obtained by painting this suspension at the desired bremsstrahlung by means of a Geiger counter. The loss of electrons by absorption in the titanium is then only about 10%. (auth)

6763 A/CONF.15/P/2503

APPLICATION OF NUCLEAR SPECTROSCOPY METHODS TO BETA-GAMMA-RAY DOSIMETRY. K. K. Aglintsev, V. P. Kasatkin, V. V. Mitrofanov, and V. V. Smirnov (U.S.S.R.). 15p.

The angular distribution and energy spectra of secondary electrons knocked out by Cs^{137} and Co^{60} gamma radiation from graphite, plexiglas, aluminum, copper, cadmium, and lead were investigated. A 270° magnetic spectrometer with a homogeneous magnetic field was used. The back reflection of Y^{91} and Tl^{204} beta particles from target materials used in the experiment was studied. (W.D.M.)

METALLURGY AND CERAMICS

6764 A/CONF.15/P/25

COMPATIBILITY OF REACTOR MATERIALS IN FLOWING SODIUM. M. Davis (United Kingdom Atomic Energy Authority. Culcheth, Lancs, Eng.), and A. Draycott (Atomic Energy Commission, Australia). 36p.

The validity of various types of compatibility tests is briefly discussed, particularly the severe limitations of static experiments. Differences expected between sodium and NaK are noted. A typical corrosion test rig is described and its application to radioactive mass-transfer measurements discussed. The types of specimens used, the measurements made before and after tests, the assessment of the results, and their correlation with reactor circuits are detailed. The variables studied include the temperature of the specimen, the velocity of the liquid metal over the specimen, the oxide level in the liquid metal and the initial state of the specimen. The materials investigated include stainless steel, various ferritic steels, zirconium, niobium, vanadium, uranium and fission products, thorium, and beryllium. Niobium and vanadium were studied in greatest detail. (auth)

6765 A/CONF.15/P/27

THE TRANSFORMATION BEHAVIOUR OF SOME DILUTE URANIUM ALLOYS. M. D. Jepson, R. D. Kehoe, R. W. Nichols, and G. F. Slattery (United Kingdom Atomic Energy Authority, Springfields, Lancs, Eng.). 25p.

Metallographic and dilatometric studies of the heat treatment behavior of technical uranium and certain alloys of interest for use in natural-uranium fuelled reactors are described. The micro-structure and secondary phases present in high purity and technical purity uranium are first discussed and the time-temperature-transformation data presented. Results on binary alloys comprising U/Al, U/Cr, U/Fe, U/Mo, U/Nb, U/Ti, U/V, and U/Zr, containing up to about 2 at. % of the alloying element, are described. Cr, Fe, and Zr were found to be the most effective grain refining agents. Al and V were satisfactory under some conditions whereas Mo, Nb, and Ti were ineffective. The grain-size results together with the time-temperature-transformation curves indicated that grain refinement is associated with depression of the temperature of transformation on heat treatment, the extent of this depression for a given cooling rate being dependent on the alloy content. In practice it was found that alloys such as U/Zr and U/Fe responded to water quenching treatments, and optimum refinement of others (e.g., U/Cr) resulted from isothermal treatment at 500 to 600°C. (auth)

6766 A/CONF.15/P/30

THE EFFECT OF METAL SPECIES PRESENT IN IRRADIATED FUEL ELEMENTS ON THE CORROSION OF STAINLESS STEEL IN NITRIC ACID. A. B. McIntosh (United Kingdom Atomic Energy Authority, Culcheth, Lancs, Eng.), and T. E. Evans (Mond Nickel Co., Ltd., London). 21p.

The presence in solution of dichromate ions or the oxidized members of other redox couples, e.g., Ce(IV) or Ru(VIII), leads to accelerated attack of stainless steel by nitric acid. Chemical processing of irradiated reactor fuel elements may involve dissolution by nitric acid in stainless steel chemical plant and, since isotopes of cerium and ruthenium normally present as fission products will also pass into solution, accelerated corro-

sion rates are to be expected. Observed corrosion rates are found to be much lower than those predicted on the basis of laboratory experiments conducted under non-irradiated conditions. This is because the beta-gamma activity of the fission products maintains the oxidation potential of the solution below that at which the cerium and ruthenium are stable in their tetravalent and octavalent states, respectively. For similar reasons, accelerated corrosion may be inhibited by certain reducing agents. The mechanism of corrosion in boiling nitric acid and the influence of the oxidizing species are discussed. (auth)

6767 A/CONF.15/P/49
HIGH TEMPERATURE PROPERTIES OF URANIUM AND ITS ALLOYS. A. B. McIntosh and T. J. Heal (United Kingdom Atomic Energy Authority, Culcheth, Lances, Eng.). 48p.

Data are presented on the mechanical and physical properties of high-purity and normal uranium and for a range of dilute uranium alloys at temperatures up to 700°C. The results of thermal conductivity and thermal expansion determinations for a range of alloys are discussed, and some results on the latent heat of fusion and volume change on melting are presented. Results of dilute alloy creep tests are reported and correlated with thermal cycling data and resistance to swelling under irradiation. (J.R.D.)

6768 A/CONF.15/P/71
THE PHYSICAL METALLURGY OF PLUTONIUM. M. B. Waldron, J. Garstone, J. A. Lee, P. G. Mardon, J. A. C. Marples, D. M. Poole, and G. K. Williamson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 24p.

Some physical properties of plutonium were redetermined using high-purity metal, including transition temperatures by thermal analysis and dilatometry, expansion coefficients, and thermo-electric power. Thermal properties and the kinetics of the $\alpha \rightleftharpoons \beta$ transformation were studied on metal of lower purity. The effect of aluminum additions on the negative expansion coefficient of the delta-phase was studied over the range 30 to 600°C. Partial or complete phase diagrams are presented for the alloy systems of plutonium with aluminum, iron, thorium, uranium, zirconium, and ternary uranium–molybdenum–plutonium alloys. (auth)

6769 A/CONF.15/P/81
SWELLING AND INERT GAS DIFFUSION IN IRRADIATED URANIUM. R. S. Barnes, A. T. Churchman, A. J. E. Foreman, O. S. Plail, S. F. Pugh, and G. N. Walton (Atomic Energy Research Establishment, Harwell, Berks, Eng.), and G. C. Curtis, V. W. Eldred, J. A. Enderby, and L. M. Wyatt (United Kingdom Atomic Energy Authority, Sellafield, Cumb., Eng.). 72p.

The increases in volume which occur when uranium is irradiated are of considerable importance in nuclear engineering since they impose a ceiling to irradiation levels and efficiency. These limitations may be overcome to some extent by principles of design or by the development of improved materials based on an understanding of the fundamental processes involved in swelling. Much of the swelling encountered is a result of the formation of fission products. In particular, bubbles of the inert gases may form and grow at elevated temperatures, and the factors which control these processes are of outstanding interest. Experiments designed to determine changes in density and dimensions in uranium on irradiation at temperatures below about 800°C are described and results reported. Severe swelling occurred at the higher temperatures. The total amount of gaseous fission products released from specimens during irradiation was small unless swelling reached a critical value. Further changes in volume may occur in uranium if it is annealed above the irradiation temperature after removal from the pile; the presence of irradiation, other than to produce the rare gases, is not essential for swelling. Two investigations, involving material of about 0.4 and 0.2% burnup, respectively, are described. In both cases annealing treatments were carried out at temperatures between 550 and 1,000°C, and sufficient bubbles to account for the swellings observed were generally detected on subsequent metallographic examination. Factors involved in the nucleation and growth of such bubbles are considered in the light of the results. The emission of xenon and krypton from uranium into a stream of carrier gas during irradiation has been measured. For foils which were thick compared with the recoil range there was evidence that some type of diffusion process was operating in addition to surface recoil. The apparent diffusion coefficients were found to be greater than those determined in out-of-pile experiments and possible reasons for this are put forward. The rate of escape of inert gases from uranium during short out-of-pile anneals in vacuo, after irradiation to 0.15% burnup or less, followed approximately a diffusion law, and diffusion constants were estimated for various temperatures in the range 400 to 900°C. Activation energies obtained in this way were low, suggesting grain-boundary diffusion. The part played by diffusion as a factor in swelling is discussed and the effect of bubble formation on the apparent diffusion constants is considered. Methods of calculation, which in some cases have given increases in volume in reasonable accord with observation, have been developed, and improvements in knowledge of the properties of uranium, particularly under creep conditions, are leading to better agreement. The remaining anomalies may be accounted for in a number of ways which are discussed. (auth)

6770 A/CONF.15/P/125
MESURE DE L'EPAISSEUR DES COUCHES MINCES PAR RETRODIFFUSION β. (A β Back Scatter Method for Measuring the Thickness of Thin Layers.) Louis Danguy and Fernand Grard (Inst. Interuniversitaire des Sciences Nucléaires, Brussels and Faculté Polytechnique de Mons, Belgium). 15p.

The beta radiation back-scattered by strips of varying thickness was studied. It was found that the low-energy spectrum of the back-scattered radiation is independent, as a first approximation, of the atomic number Z of the scattering element. The spectrum is richer in hard radiation when Z is large. The greater the thickness of the back-scatterer, the richer the spectrum is in high-energy electrons. The possibility for improving the method for measuring thicknesses by filtering the back-scattered radiation was then investigated. The conditions giving the maximum sensitivity were determined. With the usual beta emitters used, it is possible to measure thicknesses from 2 to 200 mg/cm^2 with an error less than 1%. (J.S.R.)

6771 A/CONF.15/P/127
CORROSION OF STEEL IN THE PRESENCE OF H_2S. J. J. Point (Inst. Interuniversitaire des Sciences Nucléaires, Brussels and Faculté Polytechnique de Mons, Belgium). 13p.

It is known that H_2S accelerates steel corrosion. Radioactive tracers were used in this investigation to clarify the mode of action of H_2S. Sulfur-35 was used in an investigation of the internal and superficial distributions of sulfur and Tl^{204} for localization of the cathodes. A description is given of the experimental techniques. A study was made of corrosion by H_2S in an aqueous deaerated acid medium of mild steels recrystallized at 700°C following critical hardening. The corrosion by gaseous H_2S saturated with water of samples under tension and without tension was investigated. (W.L.H.)

6772 A/CONF.15/P/142
THE SINTERING OF URANIUM DIOXIDE. Ulf Runfors and Roland Kiessling (AB Atomenergi, Stockholm); and Nils Schönberg (Kohlswa Jernverks AB, Kolsva, Sweden). 13p.

Sintering of uranium dioxide was studied as a function of powder characteristics, compacting parameters, and sintering conditions such as temperature, furnace type, and sintering atmosphere. The importance of the prehistory of the powder is shown, and the different methods used for characterizing the powder are reviewed. The influence of the different parameters mentioned on different properties of the sintered pellets, such as pore shape, size, and distribution, crystal growth, and thermal conductivity, are discussed. Possible mechanisms of sintering are discussed. (auth)

6773 A/CONF.15/P/167
USE OF RADIOISOTOPES FOR THE STUDY OF SELF DIFFUSION IN OXIDE SYSTEMS. R. Lindner (Chalmers Tekniska Högskola, Goteborg). 9p.

Radioisotopes have been used to measure the selfdiffusion of cations in oxides and oxide systems as spinels and silicates in a number of cases. A great part of this work has been performed at Chalmers Institute of Technology, and a survey is given on all measurements available up to now in literature. The values are discussed from the point of view of limits of error and reproducibility. A general relation is found between the charge of the cations and the activation energy for selfdiffusion. A general rule is stated according to which the selfdiffusion constant extrapolated to the melting point of the respective oxide shows a value of about 10^{-7} to 10^{-6} cm^2 sec^{-1}. The importance of the measurements for elucidating the mechanism of solid state reactions and especially metal oxidation is stressed. Some connections of the results with the eventual future development of nuclear technology are mentioned. (auth)

6774 A/CONF.15/P/181
SOME TYPES OF MEMBRANES FOR ISOTOPE SEPARATION BY GASEOUS DIFFUSION. M. Mårtensson, K. E. Holmberg, et al. (Royal Inst. of Tech., Stockholm). 23p.

Two types of plane membranes for gaseous diffusion are described. The first type is produced by the electrolytic oxidation of aluminum foil. The second type is made by precipitating a fine aluminum powder on fine-mesh nickel wire gauze followed by compacting and sintering. Testing of the permeability and separation efficiency of both types with H_2-CO_2 and CO_2-N_2 mixtures, respectively, is described. The behavior towards UF_6 is still largely unsettled. (W.D.M.)

6775 A/CONF.15/P/182
THE PRODUCTION OF URANIUM DIOXIDE BODIES FOR FUEL ELEMENTS. Ulf Runford and Roland Kiessling (AB Atomenergi, Stockholm), and Nils Schönberg (Kohlswa Jernverks AB, Kolsva, Sweden). 17p.

The fabrication technique for the production of uranium dioxide pellets from powder is described. The starting material is homogeneously precipitated ammonium uranate powder. Different steps in the production include calcining to UO_3, reduction to UO_2, mixing, pressing, and sintering. Dense pellets with less than 5% porosity evenly distributed on small pores, good dimensional tolerances, and good corrosion resistance are obtained. The pellets are ground to close tolerances both on the end and circumferential surfaces. Each of the different steps is described, and the present technique is compared with earlier methods. The health precautions with regard to air activity are reviewed. (auth)

6776 A/CONF.15/P/192
THE FABRICATION AND PROPERTIES OF URANIUM DIOXIDE FUEL. G. H. Chalder and L. C. Watson (Atomic Energy of Canada Ltd., Chalk River, Ont.); N. F. H. Bright (Dept. of Mines and Technical Surveys, Can.); and D. L. Paterson (Canadian Westinghouse Co., Ltd., Hamilton, Ont.). 33p. (AECL-602). $0.25 (AECL).

The decision was made to use uranium dioxide as the fuel core for the Canadian heavy-water-cooled Nuclear Power Demonstration reactor. Since a high mass ratio of fuel to sheath was required in order to minimize sheathing cost, research and development were directed to the fabrication of uranium dioxide fuel elements up to 2.5 cm diameter. In addition, a high fuel density was required to produce a high thermal conductivity and to aid in the retention of fission-product gases by the fuel. Uranium dioxide samples prepared by different chemical routes and fabricated under identical conditions have densities ranging from 71 to 98% of theoretical. The fabrication of uranium dioxide bodies by cold pressing followed by sintering in hydrogen was developed to a commercial scale. Densities of 93 to 96% of theoretical are achieved by cold pressing uranium dioxide powder at 3 tons/cm^2 followed by sintering for 1 hour at 1600°C in hydrogen. The use of neutral and oxidizing atmospheres during the sintering of uranium dioxide was investigated to evolve a more economical fabrication cycle. Relative densities up to 98% were achieved by sintering in a steam atmosphere at 1400°C. The effect of additives on the sinterability of uranium dioxide bodies was also investigated. Marked increases in sintered density were noted for small additions of titanium dioxide, vanadium pentoxide, and niobium pentoxide. Conversely, carbon additions have a deleterious effect on the sinterability of uranium dioxide. Integral fabrication of fuel elements by cold swaging uranium dioxide powder inside Zircaloy tubing to densities of up to 95% of theoretical was demonstrated. The relation of swaged density to tap density and particle density of the uranium dioxide as well as to the section reduction in swaging and the mechanical properties of the sheathing material are being determined. (auth)

6777 A/CONF.15/P/194
CHALK RIVER EXPERIENCE WITH ZIRCALOY-2 AND ALUMINUM-NICKEL-IRON ALLOYS IN HIGH-TEMPERATURE WATER. F. H. Krenz and G. J. Biefer (Atomic Energy of Canada Ltd., Chalk River, Ont.) and N. A. Graham (Canadian Westinghouse Co., Ltd., Hamilton, Ont.). 21p. (AECL-604). $0.25(AECL).

Experience was obtained in static autoclaves (300°C)

and in loops (260°C) in which samples of aluminum and zircaloy are exposed to high-temperature water flowing at 8 to 10 meters/sec, under power-reactor conditions, in which the alloys were used to sheath UO_2 fuel elements dissipating heat in excess of 100 watts/cm^2. Long-time corrosion tests were done on extruded Zircaloy-2 tubing in static water at 360°C. A corrosion rate of 0.17 mg/dm^2/day resulted. Similar tests were carried out in steam at about 100 atmospheres and in the temperature range 400 to 540°C. The results show that there is a large difference between material extruded and annealed in the α phase and that cooled from the β phase, the latter showing the lower corrosion rates. The effect of hydrogen was investigated in the range 10 to 1200 ppm. In water at 343°C, no significant effect on the corrosion rate up to 110 days was observed. The effect of transition corrosion on subsequent corrosion was investigated in flowing water at 276°C. Samples were pre-corroded in steam at 400°C for 6 weeks after transition corrosion had set in. Subsequent corrosion tests are in progress in flowing water at 276°C, and interim results show that the corrosion rate is not influenced by the pretreatment. Aluminum alloys based on the Al–Ni–Fe system were investigated. The best alloy found to date contains 2.0% Ni, 0.5% Fe, 0.2% Si, 0.05% Be, 0.05% Zr, 0.2% Ti, and has a static corrosion rate of 1.3×10^{-3} cm/yr. Tests carried out in fast flowing water at 260°C demonstrate that the corrosion rate is strongly affected by the total exposed area of aluminum in the loop. (auth)

6778 A/CONF.15/P/217

THE ADSORPTION OF TRACERS ON MINERAL PARTICLES. G. G. Eichholz and W. N. Roberts (Dept. of Mines and Technical Surveys, Ottawa). 22p. (AECL-627). $0.25(AECL).

A study was made of the process of radioactivation of particles by adsorption of tracers from solutions. Applications are discussed in the development of procedures for the concentration and recovery of minerals from ores. Methods used for tagging the mineral particles are reviewed. Special problems are considered which are encountered in the use of tracers in flotation circuits where several possibly conflicting surface reactions take place simultaneously and the tracer must not interfere with normal flotation conditions. In view of the fact that in flotation systems the ore slurries are mixtures of minerals, attempts were also made to find possible markers which would be taken up selectively by different minerals. The minerals studied included marmatite, galena, pyrite, cassiterite, silica, siliceous gangue, and sphalerite. Methods used to test adsorption rates are described. Data are presented graphically on the adsorption of copper, silver, zinc-65, silver-110, barium-140, lanthanum-140, cerium-144, tin-113, and cesium-137 under various conditions of pH and concentration. Data are tabulated on the comparative adsorption by mill products of iron-59, cobalt-60, copper-64, zinc-65, silver-110, cadmium-115, cesium-137, cesium-144, europium-152 + 154, and mercury-203. (C.H.)

6779 A/CONF.15/P/270

LIQUID METAL FUEL TECHNOLOGY. B. R. T. Frost (Atomic Energy Research Establishment, Harwell, Berks, Eng.), C. C. Addison (Univ. of Nottingham), A. Chitty (General Electric Co., Ltd., Wembley, Eng.), G. A. Geach (Assoc. Electrical Industries, Ltd., Aldermaston, Berks, Eng.), P. Gross (Fulmer Research Inst., Stoke Poges, Eng.), J. A. James (British Thompson Houston Co., Ltd., Rugby, Eng.), G. J. Metcalfe (Hawker-Siddeley Nuclear Power Co., Ltd., Langley, Eng.), T. Raine Metropolitan-Vickers Electrical Co., Ltd., Manchester, Eng.), and H. A. Sloman (National Physical Lab., Teddington, Eng.). 65p.

The work carried out at a number of laboratories on the metallurgical problems associated with the development of liquid metal fuelled reactors is outlined. The major effort has been concerned with a circulating fuel thermal system which employs a fuel of uranium dissolved in bismuth and a thorium-bismuth slurry blanket. However, a considerable amount of work has been done on a fast reactor concept. The development of suitable fuels has called for extensive work on solutions and suspensions of uranium and plutonium and their compounds in liquid metals. This has included the determination of solubility/temperature curves, the identification of intermetallic compounds, the measurement of thermodynamic activities, and the study of particle growth in suspensions or slurries. (auth)

6780 A/CONF.15/P/305

THE MECHANICAL AND PHYSICAL PROPERTIES OF MAGNESIUM AND NIOBIUM CANNING MATERIALS. T. J. Heal (United Kingdom Atomic Energy Authority. Culcheth, Lancs, Eng.). 40p.

The magnesium alloys used as canning materials for the Calder Hall thermal reactors are required to operate as ductile extensible envelopes allowing growth and deformation of the uranium fuel while at the same time suppressing the carbon dioxide-uranium interaction and the release of fission product gases. Mechanical properties relevant to these requirements are reported for a number of magnesium alloys for the temperature range of interest. Magnesium alloys are subject to grain boundary cavitation which is shown to affect the ductility of the material and leads to the possibility of permeable paths forming along the grain boundaries of thin walled cans. Theories advanced to explain the phenomena are discussed in relation to the results obtained. The dependence of the properties of these alloys on their structure was investigated, and the results are discussed in relation to possible fabrication routes. The niobium used as a canning material for the Dounreay Fast Reactor is required to possess both high temperature strength to limit the deformation and swelling of the fuel and sufficient ductility to allow confidence in the ability of the cans to expand without fracture up to limits set by design criteria. Mechanical properties relevant to these requirements and to the requirements of the production route were determined. The effect of heat treatment and gaseous contamination was studied, and some work is reported on the strain aging of the metal and on the effect of alloying additions on the mechanical properties. (auth)

6781 A/CONF.15/P/318

CERAMIC AND CERMET FUELS. P. Murray and J. Williams (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 25p.

The fabrication of UO_2 by sintering, hot pressing, warm pressing, and direct swaging of the oxide powder in metal sheaths is discussed. The oxidation of UO_2 in air and in CO_2 and the compatibility of both stoichiometric and nonstoichiometric oxide in liquid sodium are considered. The preparation and fabrication of UC by various methods are discussed. Consideration is given to dispersed systems of these compounds, with particular reference to the fabrication and properties of car-

bides dispersed in graphite as high temperature fuels in gas-cooled reactors. (W.D.M.)

6782 A/CONF.15/P/319

SOME ASPECTS OF THE FABRICATION TECHNOLOGY OF BERYLLIUM AND BERYLLIA. D. T. Livey and J. Williams (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 22p.

Cold-compacting and sintering, hot-compacting, and slip-casting have been investigated as methods for the fabrication of beryllium oxide powders prepared by decomposition of the hydroxide. The thermal decomposition of beryllium hydroxide obeys a unimolecular law with an activation energy of 14.7 kcal/mole. Decomposition is not complete below 500°C. As the temperature of calcination of the hydroxide increases above 500°C, the surface area and activity of the powder decrease. For calcination temperatures in the range 500 to 900°C the powder produced has a surface area of approximately 100 m^2/g. Such powder cold-compacts poorly, and low sintered densities result (~ 2.0 g/cm^3). Addition of a fluxing agent such as lime enables densities of ~ 2.6 g/cm^3 to be attained. These very active powders hot-compact readily to ~ 2.8 g/cm^3 at 1400°C. The oxide produced using calcination temperatures of 1000 to 1200°C is less active, having a surface area of ~ 10 m^2/g. Its cold-compacting and sintering behavior is better than that of the more active material, and densities of 2.7 g/cm^3 are obtained. The hot-compacting properties deteriorate with the decreased activity. This type of oxide powder can be used to give slip-cast ware of very high green strength, but of relatively poor sintering properties. Further increase of calcination temperature (> 1400°C) diminishes the surface area to below 5 m^2/g. The cold-compacting and sintering behavior of these powders is poor but can be improved by lime additions; their poor hot-compacting behavior can be improved by powder comminution. The corrosion of beryllium in wet and dry carbon dioxide at atmospheric pressure has been investigated for the temperature range 500 to 700°C. At 500°C the corrosion rate in both wet and dry gas is negligible; at 600°C the corrosion film is protective in the dry, but not in the wet gas; at 650°C and 700°C the surface film is no longer protective even in the dry gas. Comparison of the corrosion behavior in dry oxygen and dry carbon-dioxide suggests that beryllium carbide formation may become significant at 650°C and render the oxide film non-protective. Of the various types of fabricated beryllium available those showing the smallest departure from isotropy with regard to mechanical properties are probably most suitable for use as a canning material for uranium. Two methods of canning uranium in beryllium have been developed which avoid the necessity of a can closure by fusion welding. The sheath forging process is an integral canning technique in which the can is formed by consolidating beryllium powder around a uranium core. Consolidation is achieved by hot forging the powder and core within a steel can at about 1000°C. In the second method end closure is obtained during co-extrusion of uranium within beryllium in the range 400 to 500°C. The thermal-cycling behavior of these two types of element is described. (auth)

6783 A/CONF.15/P/320

PRESSURELESS SINTERED BERYLLIUM POWDER. T. R. Barrett, G. C. Ellis, and R. A. Knight (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). 25p.

A new process, termed pressureless sintering, has been established for the production of beryllium shapes (solid or hollow) to near theoretical density. It consists simply of the vacuum sintering at 1,200°C of loose powder of critical particle size distribution, without the application of pressure. Notable advantages are claimed over conventional powder production and consolidation methods. The process is particularly suited for the production of beryllium fuel cans, structural components, and moderators for reactor application. Particular significance is attached to the direct production of beryllium canned fuel elements by sintering loose powder around a uranium ceramic core. (auth)

6784 A/CONF.15/P/327

QUELQUES PROPRIETES DU PLUTONIUM ET DE L'ALLIAGE ALUMINIUM–PLUTONIUM. (Some Properties of Plutonium and Its Alloys.) R. Abramson, R. Boucher, R. Fabre, and H. Monti (Commissariat à l'Énergie Atomique, Paris). 28p.

The results of a dilatometric study of the phase changes of very pure plutonium are reported. Very sharp phase changes with strong expansions from one phase to the other were observed. The $\delta \rightleftharpoons \delta'$ and $\delta \rightleftharpoons \epsilon$ transitions are very clear. The existence of a second order transformation in the δ phase on cooling was detected. The $\delta \rightleftharpoons \delta$ transformation is very rapid with a discontinuous character and it is independent of the cooling rate. In the ϵ phase the metal is plastic with deformations caused by very weak stresses. Al–Pu alloys were prepared with from 5 to 60 wt. % Pu. A comparative thermal analysis was made of Al–Pu and Al–U alloys and a precise determination was made of the temperature and eutectic compositions. The temperature of the peritectic reactions $UAl_3 + liq \rightarrow UAl_4$ and $PuAl_3 + liq \rightarrow PuAl_4$ was also determined. The coalescence kinetics of the Al–$PuAl_4$ eutectic were studied by a micrographic method and by following the evolution of hardness. The $PuAl_3 \rightarrow PuAl_4$ transformation to the solid state was investigated. (J.S.R.)

6785 A/CONF.15/P/767

CORROSION OF ALUMINIUM WITH ADDITIONS OF IRON AND SILICON IN HIGH-TEMPERATURE WATER. Ketil Videm (Joint Establishment for Nuclear Energy Research, Kjeller, Norway). 19p.

Aluminum alloys with different contents of Fe and Si have been corrosion tested in demineralized water at 150 and 200°C in autoclaves and in a loop. It is found that the alloys may suffer three different kinds of attack: uniform attack, grain boundary attack, and blistering attack. A too-low iron content and a too-high silicon content lead to grain boundary attack. A too-low silicon content leads to formation of blisters after long exposure, and a high iron content seems to increase the uniform corrosion rate. A careful balance between iron and silicon is therefore needed to obtain the best corrosion resistance. (auth)

6786 A/CONF.15/P/964

SOME PROPERTIES OF URANIUM MONOCARBIDE. A. Boettcher and G. Schneider (Degussa, Frankfurt a. M.). 6p.

The properties of UC that are essential for its application as a nuclear fuel are discussed. Various methods for producing UC are discussed along with the composition of the resulting product. Mechanical, thermal, electrical, and corrosion properties are briefly discussed. The reaction of UC with other metals is discussed at length. (W.L.H.)

6787 A/CONF.15/P/1091
THE COMPATIBILITY OF BERYLLIUM WITH LIQUID SODIUM AND NaK IN DYNAMIC SYSTEMS. F. L. Bett and A. Draycott (Australia). 16p.

The mechanism of corrosion of beryllium in oxygen-bearing sodium and NaK is briefly discussed. Experiments are described which measure the rate of corrosion of beryllium in cold-trapped NaK. These corrosion rates are found to be excessive. As oxygen in the liquid metal is considered to be the cause of the corrosion, cold trapping is supplemented by hot trapping as a means of deoxidation of NaK in a second series of experiments. These experiments show that with a thorium hot-trap reduced corrosion of beryllium occurs compared with cold-trap conditions, but is still excessive. Calcium, however, when used in the hot-trap reduces beryllium corrosion to an acceptable level. At the levels required for successful hot-trapping calcium removes negligible quantities of nickel from stainless steel which can therefore be used as a container material. (auth)

6788 A/CONF.15/P/1097
URANIUM ALLOY POWDERS BY DIRECT REDUCTION OF OXIDES. R. H. Myers and R. G. Robins (New South Wales Univ. of Tech., Kensington, N.S.W., Australia). 15p.

A process is outlined for the production of uranium alloy powders by co-reduction of mixtures of uranium oxide and alloy element oxides. The reduction of mechanical mixtures of the oxides of uranium and alloy element with calcium in a sealed reaction vessel is shown to produce powder with a variation in particle composition, although of consistent composition over various size fractions. The particular alloy systems which are considered are uranium–nickel, uranium–chromium, uranium–molybdenum, and uranium–niobium. The uranium–molybdenum and uranium–niobium powders are single phase (metastable gamma), which is of consequence in the production of dimensionally stable nuclear fuels. Potential applications of some of these alloys are discussed. (auth)

6789 A/CONF.15/P/1136
L'ENERGIE NUCLEAIRE EN SIDERURGIE. (Some Practical Aspects of the Use of Nuclear Energy in Steel Industry.) P. Bergognon, R. Bourion, and R. Gibrat (Indatom, Paris). 24p.

The energy needs and energy consumptions of the iron and steel industries are surveyed for the possibility of using a nuclear reactor to supply some of this energy. The use of a nuclear reactor to preheat the air of the blast furnaces is considered as a typical example. The activation of the dust particles by the reactor neutron flux creates a radiation problem which is discussed. An economic appraisal shows that in the French industry, nuclear reactor heating might be feasible. (J.S.R.)

6790 A/CONF.15/P/1146
CORROSION DU MAGNESIUM ET DE CERTAINS DE SES ALLIAGES DANS LES PILES REFROIDIES PAR GAZ. (Corrosion of Magnesium and Some Magnesium Alloys in Gas Cooled Reactors). R. Caillat and R. Darras (Commissariat à l'Énergie Atomique, Paris). 48p.

The results of corrosion tests on magnesium and Mg–Zr and Mg–Zn–Zr alloys in dry and moist air and in CO_2 are reported. The corrosion of Mg in dry air is very slow even at 500°C. The maximum temperature for exposure of Mg to moist air without risk of corrosion is 350°C. Above 350°C the oxidation follows a linear law. Neutron irradiation appears to have no effect on the oxidation in either dry or moist air. If moist air is slightly charged with fluorinated compounds, the maximum temperature before corrosion occurs is 500°C. In dry CO_2 the oxidation of Mg and its two alloys is very slow even at 500°C. In CO_2 at 15 atm the oxidation is low for all three samples, but the behavior of the Mg–Zr alloy is the best. A neutron flux appears to have a negligible effect on the corrosion under these conditions. No important corrosion was observed in Mg–Zr alloys heated to 450°C in CO_2 charged with water vapor. (J.S.R.)

6791 A/CONF.15/P/1148
OXYDATION D'UN ACIER ORDINAIRE CHAUFFE DANS LE GAZ CARBONIQUE SOUS PRESSION. (Oxidation of Steel Heated in CO_2 Medium Under Pressure). R. Darras, D. Leclercq, and C. Bunard (Commissariat à l'Énergie Atomique, Paris). 16p.

The behavior of low-alloy steels heated up to 400°C in CO_2 under pressure is reported. The observed weight increases were small, even after more than a thousand hours of heating. The oxidation curve is linear. The oxide formed at a pressure of 15 kg/cm^2 is more compact and adherent than the one formed at a pressure of 1 kg/cm^2. The passivation treatments appear to have no effect on the behavior of the steel in CO_2 atmospheres. (J.S.R.)

6792 A/CONF.15/P/1158
ETUDE SUR L'URANIUM IRRADIE. (Study on Irradiated Uranium.) J. Bloch, J. P. Mustelier, P. Bussy, and J. Blin (Commissariat à l'Énergie Atomique, Paris). 31p.

Recrystallization and hardness in uranium irradiated at 220 Mwd/t were studied during successive annealings by following the evolution of micrographies. Some measurements of density were also made. It was observed that the initial state of the irradiated metal and its restoration differed little from cold-worked metal. Recrystallization was not observed by heating beyond the α phase. It is necessary to pass the β region to observe it. The effect of very weak irradiations (integrated flux of 10^{16} nvt) on uranium was studied by measurements of the hardness. Hardness does not increase linearly with the flux, but there is a period of incubation which represents the time necessary for the saturation of the dislocations. (J.S.R.)

6793 A/CONF.15/P/1160
DIFFUSION DE L'URANIUM AVEC QUELQUES METAUX DE TRANSITION. (Diffusion of Uranium with Various Transitional Metals). Y. Adda (Commissariat à l'Energie Atomique, Paris) and J. Philibert (Inst. de Recherches de la Sidérurgie, France). 38p.

The diffusion process in uranium and its alloys was studied from 550 to 1075°C with diffusion couples of U with Zr, Mo, Ti, and Nb and with the alloys U–Nb and U–Mo. A brief description is given of the experimental methods. Results relative to the concentration-penetration curves are presented, and the coefficients of diffusion are calculated. The equilibrium diagram was established for the U–Zr system. The results obtained by micrographic examination, microhardness measurements, and autoradiography are compared with each other. The mechanisms of diffusion are investigated by studying the Kirkendall effect and calculating the Darken intrinsic coefficients in the U–Zr and U–UMo diffusion couples. (J.S.R.)

6794 A/CONF.15/P/1162
PREPARATION PAR FRITTAGE SOUS CHARGE DE CERMETS U-UC ET DE MONOCARBURE STOECHIOMETRIQUE. (Hot Pressing of U-UC Cermets and Stoichiometric Uranium Monocarbide). J. Dubuisson, A. Houyvet, E. Le Boulbin, R. Lucas, and C. Moranville (Commissariat à l'Énergie Atomique, Paris). 32p.

High-density fuels, either in uranium monocarbide or in U–UC cermets, were prepared on a laboratory-scale by hot pressing of mixtures of uranium powder and graphite in suitable proportions. Uranium powder is prepared by calcium reduction of UO_2 followed by an acid leaching at low temperature. An adequate protection treatment permits the manipulation of the powder in the open air. Uranium and graphite powders are intimately mixed and then hot pressed in a double effect graphite die at a temperature of 900 to 1000°C under a charge of 200 kg/cm^2 for 3 hours. A special design of the die avoids the breaking of the graphite during the sintering. In this way, samples are prepared with ±5% of homogeneity for a height/diameter ratio of 2 and almost theoretical density (98%). There is a low concentration of unreacted carbon and the micrographic examination shows a network of monocarbide surrounding the uranium in the case of low concentration cermets (< 2.5% C). The two networks are intimately mixed for high concentration cermets, and (> 2.5% C) there is a fine grain structure for the monocarbide (10 u). In every case, the x ray examinations show a fine grain structure without any orientation, and no UC_2. Some indications are given on the physical (thermal cycling and conductivity) and chemical properties (corrosion and reaction with cladding materials). (auth)

6795 A/CONF.15/P/1165
CONTRIBUTION A L'ETUDE DU FRITTAGE DE L'OXYDE D'URANIUM. (Contribution to the Study of the Sintering of Uranium Oxide–Technical Applications.) A. Bel and Y. Carteret (Commissariat à l'Énergie Atomique, Paris). 23p.

An investigation was made on the preparation of uranium oxide powders beginning with uranium peroxide and the examination of the behavior of these powders during sintering in a hydrogen atmosphere. The modifications of structure and granulometry which accompany the preparation of uranium oxide powders were studied, and a method of preparation of a powder suitable for sintering at 95% of the theoretical density in hydrogen at temperatures from 1200 to 1400°C is described. The determinant factor in assuring the success of sintering is the choice of the primary material whose surface must not be less than 8 to 10 m^2/g. (J.S.R.)

6796 A/CONF.15/P/1166
MAGNESIUM, ALUMINIUM ET ALLIAGES. EMPLOI COMME MATERIAUX DE STRUCTURE. (Mg- and Al-Base Products, for use as Structural Materials.) J. Bernard, B. Boudouresques, L. Alfille, and R. Klersy (Commissariat à l'Énergie Atomique, Paris). 161p.

The use of some Mg and Al base products as structural materials in thermal reactors is investigated. The physical and mechanical properties of unalloyed Mg between room temperature and 450°C were first investigated. As grain coarsening occurs in Mg held at elevated temperatures, similar tests were made on Mg–Zr alloys which have a grain-refined structure. Results are presented on creep strength tests at high temperatures for Mg–Ce, Mg–Th, Mg–Th–Zr, and Mg–Th–Zn–Zr alloys. Creep strength tests were also made on sintered and extruded unalloyed Mg. The mechanical behavior of Al and Al alloys is also studied, but in much less detail. The effect of irradiation on the mechanical properties of some of these alloys was considered. (J.S.R.)

6797 A/CONF.15/P/1169
TESTS ON DYNAMIC CORROSION BY WATER; EFFECT OF THE PASSAGE OF THE THERMAL FLUX ON THE CORROSION KINETICS. MEASUREMENT OF THE pH IN HIGH TEMPERATURE WATER. Berthod, [H]. Coriou, Fournie, [L]. Grall, [J]. Hure, LePeintre, and [R]. Saint-James (Commissariat à l'Énergie Atomique, Paris). 39p.

A low-pressure closed circuit was designed for corrosion tests on aluminum jackets. The loop is described in detail, and the results obtained with it are reported, with special emphasis on cavitation phenomena. A description is given of the high-pressure loop designed for corrosion tests on Zircaloy or stainless steel jackets. A glass electrode which can be used for pH measurements under pressure and temperatures up to 100°C is described. (J.S.R.)

6798 A/CONF.15/P/1258
THE DEVELOPMENT OF LARGE PERFECT CRYSTALS OF URANIUM BY COLD HAMMERING AND ANNEALING OF POLYGONIZED CRYSTALS OBTAINED BY $\beta \rightarrow \alpha$ PHASE SHIFT. Paul Lacombe and Daniel Calais (Centre de Recherches Métallurgiques de l'Ecole des Mines, Paris). 30p.

The preparation of imperfect phase-shift crystals is described. A study is made of plastic deformation by traction as a function of the orientation of the crystal, comparing the changes in the micrographic structure with those noted on the traction curve. The relationship between plastic deformation and the evolution of its structure by annealing about the α phase was determined. Optimum conditions for the growth of large perfect grains of α uranium are described. (W.D.M.)

6799 A/CONF.15/P/1271
ALLIAGES D'ALUMINIUM CONTENANT DU FER ET DU NICKEL. MECANISME ET CINETIQUE DE CORROSION DANS L'EAU ET LA VAPEUR A HAUTE TEMPERATURE. FACTEURS STRUCTURAUX. RECHERCHES SUR LA FABRICATION D'ALLIAGES RESISTANTS. (Mechanism of Corrosion in High Temperature Water of Aluminum and Alloys Containing Iron and Nickel. Structural Factors. Research to Obtain Corrosion Resistant Alloys). H. Coriou, R. Fournier, L. Grall, J. Herenguel, J. Hure, and P. Lelong (Commissariat à l'Énergie Atomique, Paris). 95p.

A comprehensive study was made of the mechanism and kinetics of corrosion of Al–Fe–Ni alloys in high-temperature water and steam. Three corrosion mechanisms were observed: production of a uniform film, production of a disordered film, and intergranular corrosion. It appeared that the basic corrosion process was identical in all experimental conditions. The corrosion of welded alloys was especially considered. Metallurgical processes and mechanisms influencing the behavior of aluminum alloys with respect to corrosion by high-temperature water were investigated. Classical metallurgical methods and powder metallurgical methods were considered. The results of this study indicate the equal importance of chemical, electrochemical, and metallurgical factors and creep char-

acteristics in the preparation of corrosion-resistant alloys. (J.S.R.)

6800 A/CONF.15/P/1272
LES ACIERS A FORTE TENEUR EN BORE. (Steels of High Boron Content.) J. Hochmann and A. Desestret (Compagnie des Ateliers et Forges de la Loire, Paris). 18p.

Because of the high thermal neutron capture cross section of boron and the physical properties of steel, boron steel has many advantages as a shielding material. The fabrication techniques used for steels containing 1 to 2% boron are described. The mechanical properties of these steels are investigated with emphasis on impact strength. The possibility of fabricating steels with 4% boron is studied. (J.S.R.)

6801 A/CONF.15/P/1274
PROCEDES DE FABRICATION DU VANADIUM ET DU NIOBIUM DUCTILES A PARTIR DE LEURS OXYGES. (Methods of Producing Ductile Vanadium and Niobium from Their Oxides.) M. F. Joly (Etablissements Kuhlmann. Centre de Recherches Metallurgiques, Brignoud, France). 26p.

The results of investigations on the preparation of pure ductile vanadium and niobium metals are reported. The pentaoxides were chosen as the starting materials because they are easily obtained in a very pure state. Calcium reduction in an inert atmosphere and carbon reduction in a vacuum were studied for both metals. Calcium reduction of the vanadium oxide gave directly massive ductile metal with a purity over 99.5%. Either sponge or massive niobium were obtained with the calcium reduction, but the bomb reduction is often hazardous. The vacuum reduction of vanadium with either vanadium carbide or carbon gave a ductile metal with very low C and O content. The kinetics of the carbide–oxide reaction is more favorable than that of the carbon–oxide reaction for niobium. The experimental procedures used are described. (J.S.R.)

6802 A/CONF.15/P/1293
L'ÉTUDE DES DISCONTINUITÉS D'ABSORPTION DES RAYONS X ET DE LA STRUCTURE CRISTALLOGRAPHIQUE DE QUELQUES ALLIAGES Fe–Ni IRRADIÉS AUX NEUTRONS. (A Study of the Absorption Edge of X-rays and the Crystalline Structure of some Fe–Ni Alloys Subjected to Neutron Bombardment). D. Bally and L. Benes (Inst. de Physique Atomique, Bucharest). 8p.

For the study of the x-ray-absorption discontinuities of Fe and Ni, a bent-crystal spectrograph of the Cauchois type with a 45-cm radius was used. The use of the ($\bar{2}01$) plane of a mica crystal led to a dispersion of 12.6 xu/mm. The diffraction images were obtained in a universal chamber 145 mm in diameter, and the crystalline lattice constants were determined by means of an RKE-type focussing chamber. Ni, Fe, and three Ni–Fe alloys with Ni concentrations of 85%, 78%, and 50% were studied. For homogenization purposes, all the objects studied were treated for 4 hours at 1000°C. After the treatment, the specimens were divided into two groups, one group being immersed in water, while the other was slowly cooled down to room temperature. All the samples were subjected to various neutron bombardments from a reactor. Also given are the measurements on the position of the K discontinuities of x-ray absorption of Ni and Fe and their fine structures, as well as the crytalline lattice constants and the relative intensities of the diffraction lines. (auth)

6803 A/CONF.15/P/1324
FUNDAMENTAL RESEARCHES IN PHYSICAL METALLURGY OF NUCLEAR FUELS IN JAPAN. Ryukiti R. Hasiguti (Tokyo Univ.) and Raisaku Kiyoura (Tokyo Inst. of Tech.). 23p.

Recent fundamental researches in the field of physical metallurgy of nuclear fuels covering chiefly metallic uranium and ceramic fuel materials are reviewed. (J.E.D.)

6804 A/CONF.15/P/1365
SELF-DIFFUSION IN THE ORDERED β-BRASS. P. Camagni (Centro Nazionale per le Ricerche Nucleari, Ispra, Italy). 7p.

Radiotracer techniques were used for a series of measurements on the coefficients of self-diffusion of Cu and Zn in ordered β-brass. A sharp dependence of self-diffusion on the state of order is observed. The results give some good qualitative information as to possible mechanism of diffusion operating in β-brass; they allow the evaluation of ordering energy for the alloy. A discussion is also given of some aspects of chemical diffusion and "drift" along a chemical gradient. The application of tracer techniques to these problems is especially considered. (auth)

6805 A/CONF.15/P/1402
BURNABLE POISONS IN ALUMINUM–URANIUM ALLOYS. G. Cesoni (FIAT, Italy) and D. Gualandi (Istituto sperimentale di Metalli Liggeri, Italy), et al. 45p.

The properties of some Al–16% U alloys containing B and Li as burnable poisons were investigated. The addition of 0.05 to 0.15% B leads structurally to the formation of an intermetallic compound probably consisting of a complex boride. The addition of B does not appreciably change either the mechanical or electrochemical properties of the alloy. Lithium when added in a large percentage (2%) produces structural variations with the formation of primary crystals of UAl_4 containing part of the Li in solid solution. There is an appreciable change in the physical, mechanical, and electrochemical properties of the alloy when Li is added in large percentages. (W.L.H.)

6806 A/CONF.15/P/1410
THE SURFACE REACTION OF COPPER WITH SODIUM POLYSULPHIDE SOLUTIONS, STUDIED BY RADIOACTIVE TRACERS. J. Llopis, J. M. Gamboa, and L. Arizmendi (Instituto de Quimica Fisica, C.S.I.C., Madrid and Junta de Energía Nuclear, Madrid). 32p.

A study was made of the action of solutions of sodium polysulfide on copper by keeping fixed-size metal plates in contact with these solutions, under appropriate conditions of agitation and temperature. Use was made of polysulfide solutions tagged with S^{35} prepared by dissolving radioactive sulfur in a solution of sodium monosulfide, and then mixing it with a suitable quantity of polysulfide solution. The specific activity was determined by measuring the radioactivity in liquid and solid samples. By combining suitable ordinary analytical methods, a determination was made of the quantity of sulfur present as monosulfide, namely Sm, polysulfide or Sp, hydrosulfide Ss, and Thiosulfate Sh, with which a computation of the polysulfiding index of the solutions $y = Sp + Sm + Ss/Sm + Ss$ could be made. The radioactivity measurements made on the copper plates, after the reaction, afford a means of computing the deposit formed in each case. The sensitivity of the methods based on the use of radioactive tracers permits a study of such reactions from the very first moments in which

they develop, with greater rigor and accuracy than what could be done with the earlier techniques. The experiments conducted at various temperatures and in the 0.5 to 60°C range show that at 60, 40 and 25°C, the respective shapes of the activity vs. time curves correspond to the same kinetic law. On the other hand, the results obtained at 17, 10 and 0.5°C reveal a change in the kinetic law. In the former case, microscopic examination of the surface of the metal plates shows the formation of cohesive films. In the latter, it would appear that the rate of corrosion is greater, due to breaks in the film and, further, that there is a critical temperature range separating two different mechanisms in the corrosion process, which give rise to cohesive or non-cohesive films, respectively. These results were confirmed by working with polysulfide solutions having different polysulfiding indices. (auth)

6807 A/CONF.15/P/1421

LA SÉPARATION DE TELLURE TRÈS PUR CONTENU DANS LES MINERAIS ROUMAINS. (The Separation of a High Purity Tellurium Contained in the Romanian Ores). R. Ripan, H. Hulubei, G. Marco, and N. Pasco (Inst. de Chimie de l'Académie de la R.P.R., Cluj). 6p.

A method is described for the recovery of tellurium from the by-products of gold and silver refining. The tellurium is separated with acetic acid and recovered by distillation. A method of purifying the crude tellurium is given. An economic process for the purification of tellurium as the water soluble product $Te(OH)_6$, used in the preparation of I^{131}, is also discussed. (J.S.R.)

6808 A/CONF.15/P/1443

URANIUM ALLOYS PREPARED BY THE POWDER METALLURGICAL INFILTRATION PROCESS. R. Kieffer and K. Sedlatschek (Metallwerk Plansee Ges.m.b.H., Reutte/Tyrol, Austria). 28p.

General rules are given for the production of infiltrated metals and approaches are outlined which permit the production of metal-metal and metal-carbide (boride, silicide, etc.) composites of materials exhibiting poor wetting infiltration characteristics. Infiltration experiments with porous sintered skeletons of refractory carbides, nitrides, silicides, and borides and liquid uranium have established that in a vacuum or under argon uranium wets well and infiltrates most of the skeleton materials studied. Provided that no extended metallurgical reaction between the skeleton material and uranium takes place, infiltrated materials can be produced by this method. (auth)

6809 A/CONF.15/P/1452

PLUTONIUM TECHNOLOGY FOR REACTOR SYSTEMS. M. B. Waldron, A. G. Adwick, H. Lloyd, M. J. Notley, D. M. Poole, L. E. Russell, and J. B. Sayers (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 17p.

The possibility exists of using plutonium in both thermal and fast reactors as solid metal, ceramic, or cermet or as liquid metal solutions or suspensions. Technological studies were undertaken to evaluate the practicability of the various concepts. For solid metallic fuels, powder metallurgy and extrusion experiments are reported; binary alloys with iron, thorium, uranium, zirconium; ternary uranium–molybdenum alloys; and cermets incorporating PuO_2. The structural stability of various cermet mixtures is also reported. The manufacture of full-scale fuel elements based on a PuO_2–thorium cermet was demonstrated as an economic production process which is suitable for α-active operation. As an example of plutonium fuels diluted with moderating substances, the behavior on compacting and structural stability of PuO_2–graphite mixtures were studied. (auth)

6810 A/CONF.15/P/1454

COMPOSITE NEUTRON-ABSORBING MATERIALS FOR CONTROL-ROD AND SCREENING APPLICATIONS. E. J. Bradbury and D. K. Worn (Mond Nickel Co. Ltd., Birmingham, Eng.); and C. R. Sutton (International Nickel Co. Inc., New York). 24p.

The advantages offered by composite materials for neutron absorbing applications, namely, high neutron absorption characteristics combined with good mechanical and corrosion properties, are known, and various methods have been developed for producing materials based on Al/B_4C and Ti/Gd_2O_3. Two new powder metallurgy techniques for the production of stainless steel clad composite materials in the desired forms are described. The two techniques are the continuous rolling of premixed powders to produce sheet and strip and a tube drawing technique for the manufacture of tubular control rod elements to within fine dimensional tolerances. In describing them, special reference is made to the production of stainless steel clad copper-base material containing 50% by volume of boron carbide. Reference is made to work on other materials, such as iron and nickel/boron-carbide, iron/gadolinium oxide, iron/europium oxide, and nickel/cadmium-fluoride. The relative merits of these combinations are discussed from both the metallurgical and nuclear points of view and in this connection the importance of compatibility between the matrix and absorbing phase is explained. The extended possibilities of composite type materials are briefly discussed with reference to the combination of two or more absorbing elements in one material to achieve optimum 'blackness' and 'burn-up' characteristics and to the production of a material, for use in fast reactors, incorporating both a moderator and a thermal neutron absorber. (auth)

6811 A/CONF.15/P/1455

MECHANICAL PROPERTIES OF ALLOYS OF MAGNESIUM AND OF ZIRCONIUM. G. C. E. Olds, J. E. Harris, R. R. Roberts, and T. B. Smith (British Thomson-Houston Co., Ltd., Rugby, Eng.); J. H. M. Draper and T. Raine (Metropolitan-Vickers Electrical Co., Ltd., Manchester, Eng.); and G. A. Geach and O. P. Hartree (Associated Electrical Industries, Ltd., Aldermaston, Berks, Eng.). 32p.

Important factors limiting design in the carbon dioxide cooled, graphite moderated, natural uranium reactor are the properties of structural support and canning materials for the fuel element. In the case of structural support materials, corrosion resistance and creep resistance at high temperatures are of major importance. New alloys of magnesium and zirconium have been studied and assessed with the aim of obtaining alloys of high creep strength at 400 to 450°C, acceptable for application in the reactor. Magnesium alloys with low neutron absorption cross section, for application as canning materials, have also been studied in order to develop a suitable material of high ductility and adequate strength over a wide temperature range. Properties of magnesium canning materials which were considered are high temperature ductility at low rates of strain, grain size stability and the effect of prestrain

on grain growth, creep strength at very low stresses at 450 to 500°C, intercrystalline cavitation during deformation, and weldability and weld properties. (auth)

6812 A/CONF.15/P/1469
THE ALLOY SYSTEMS URANIUM–TITANIUM, URANIUM–ZIRCONIUM AND URANIUM–TITANIUM–ZIRCONIUM. B. W. Howlett and A. G. Knapton (Associated Electrical Industries Ltd., Aldermaston, Berks, Eng.). 21p.

Dilatometric, metallographic, x-ray, and high-temperature x-ray methods were employed in a study of the uranium–titanium, uranium–zirconium and uranium–titanium–zirconium alloy systems. The three metals are mutually soluble in one another in their high-temperature body-centered cubic forms, and about 900°C complete solid solubility exists. There is general agreement between published versions of the uranium–titanium phase diagram, but certain aspects of the uranium–zirconium system are still controversial. A compound (ϵ) whose homogeneity range embraces the compositions UZr_2 and UZr_3 is present in the latter system, and the form of diagram in this region has been established. High-temperature x-ray methods were used to confirm the diagram at the high-uranium end. In the ternary system, the addition of less than 1 atomic per cent titanium causes the disappearance of the ($\gamma_1 + \gamma_2$) miscibility gap present in the uranium–zirconium system. Although the U_2Ti compound has a narrow homogeneity range in the binary, it dissolves up to 7 atomic per cent zirconium at 650°C. The uranium–zirconium ϵ compound does not extend far into the ternary system, the solubility of titanium at 575°C being 3 atomic per cent. No ternary compounds have been detected. (auth)

6813 A/CONF.15/P/1470
THE POWDER METALLURGY OF URANIUM. H. Lloyd and J. Williams (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 38p.

The powder metallurgy of uranium was developed in the United Kingdom concurrently with casting as a fabrication technique for the production of uranium fuel rods. Attention was concentrated almost exclusively upon the consolidation of powder produced by calcium reduction of uranium dioxide. This type of uranium powder was considerably more stable in air than that produced by the hydriding of massive uranium. The handling of powder in elaborate glove-box systems containing inert atmospheres was therefore not necessary for the investigations described. The calcium-reduced powder consistently contained over 90 wt. % of material of particle size below 300 B.S.S. mesh (~60 microns). A typical particle size distribution for this powder fraction and a typical chemical analysis are given. The spheroidal nature of the –300 mesh particles is illustrated. (auth)

6814 A/CONF.15/P/1583
ANALYSIS OF THE FUEL ELEMENTS USED IN REACTOR RA 1. R. Zucal and J. Toni (Comisión Nacional de Energía Atómica, Buenos Aires). 8p.

The uranium content in the fuel elements for the "RA-1" reactor varies from between 30 and 40% of uranous-uranic oxides in the central area to 1% at the ends. In view of the heterogeneous nature of the samples, the determinations must be made on a fraction of an over-all weighing operation, in such a way as to obtain results which are representative of a given section of the element. A study was made of the determination of uranium and of silicon, chromium, iron, and magnesium, constituents of the aluminum alloy. (auth)

6815 A/CONF.15/P/1688
ELABORATION DIRECTE DE ZIRCALOY MASSIF DUCTILE PAR CALCIOTHERMIE, SANS ADJUVANT. (The Direct Production of Solid Ductile Zircaloy by Calciothermy without any Additive). C. Decroly (Univ. of Brussels) and J. Gerard (Centre d'Etude de l'Energie Nucleaire, Brussels). 12p.

Solid ductile Zircaloy was prepared directly by the calcium thermal reduction of zirconium tetrafluoride without the presence of any additives except 1% tin and iron. The oxygen content of the metal is approximately 1,000 ppm. An outline of the behavior of the alloy under forging, rolling, and machining is given. Data are presented on the conditions of the process, especially on the material used. The efficiency of the process is excellent. The ingot need not be cast prior to rolling, forging, or machining. (J.S.R.)

6816 A/CONF.15/P/1705
SINTERING OF THORIUM AND THORIA. S. K. Kantan, R. V. Raghavan, and G. S. Tendolkar (Atomic Energy Establishment, Trombay, India). 18p.

Whereas the results previously published suggest that calcium-reduced thorium powder with a high green density cannot be sintered satisfactorily, the present work indicates that it is possible to do so and reach a high density (11.26) in the sintered product. The effect of such variables as bulk density of the powder and its particle size, compacting pressure, temperature, and time of sintering on the sintering characteristics has been studied. High-density thoria can be obtained either by hot pressing at temperatures above 1700°C or by cold compacting and sintering with the help of additives. It was thought that the use of high sintering temperature could be avoided by employing activated thoria. Accordingly activation was done both in air and in hydrogen at various temperatures and sintering done in air and under vacuum up to 1500°C, and the results of these experiments are presented. (auth)

6817 A/CONF.15/P/1725
DETERMINATION OF CURRENT EFFICIENCY IN ALUMINIUM FURNACES. László Bozóky and Daniel Vödrös (Hungarian Academy of Sciences, Budapest). 11p.

Current efficiency in electrolytic tanks of aluminum furnaces can be determined only when the electric energy consumption and the quantity of the produced aluminum are known. The electrical quantities are easy to measure to the desired accuracy. The application of radioisotopes to measuring the amount of aluminum produced is described. The isotope is added to the melt. (W.D.M.)

6818 A/CONF.15/P/1895
INVESTIGATION OF A NUCLEAR FUEL MAKING IT POSSIBLE TO USE THE KINETIC ENERGY OF FISSION PRODUCTS FOR CHEMICAL SYNTHESIS. R. F. R. Coekelbergs (Ecole Royale Militaire, Belgium), P. A. Gosselain and L. J. Schotsmans (Societe Belge de l'Azote et des Produits Chimiques, Marly, Belgium). 29p.

The ionizing power of fission products can be used to bring about chemical transformations, in the gaseous phase, with constituents made up of carbon, hydrogen, oxygen, and nitrogen. Most reactions of this type are characterized by low G values, and their production on

an industrial scale may be envisioned if an adequate type of fuel is available. Due to the short paths of fission products in the solid phase, the fuels used will inevitably have to be in a condition of very marked dispersion. Various methods for the production of uranium dispersions which may meet this condition are offered. Samples were prepared which contained up to 35% U, the balance consisting mainly of hydrated silica, alumina, or carbon. (W.D.M.)

6819 A/CONF.15/P/2043
PHASE DIAGRAMS OF CERTAIN TERNARY SYSTEMS OF URANIUM AND THORIUM. O. S. Ivanov and T. A. Badajeva (Academy of Sciences, U.S.S.R.). 39p.

The results of investigation of alloy structures and phase diagrams of certain ternary systems, including uranium, thorium, and their refractory compounds, which are of interest in the search for materials for reactor fuel elements are presented. The attention was concentrated mainly on the investigation of those parts of diagrams which referred to solid substance as being the most important for practical applications of alloys. The study of hardness, microstructure, and crystal lattice of alloys after prolonged annealing at controlled temperatures and quenching was the chief method of the investigation. The general regularity governing the arrangement of typical crystal lattices of metals in the periodic table hold for equilibrium of binary solid solutions based on the α, β, and α modifications of uranium much the same as the binary systems of titanium, iron, and other polymorphous metals. Phase diagrams of ternary systems U–Cr–Mo, U–Zr–Nb, U–Zr–Mo, U–Nb–Mo, and isothermic tetrahedrons for 800 and 1000°C of the quaternary system U–Zr–Nb–Mo are given to characterize the structure of most important alloys of uranium with the metals notable for their high solubility in γ uranium and low thermal neutron cross sections. Some regularities of the existence of γ solid solutions observed in these alloys are due to physical and chemical properties of their components and to the nature of their interaction. The experimental studies of certain thorium systems show that thorium hardly forms solid solutions with other metals due to the large size of its atom. Continuous series of solid solutions are found in binary systems Th–Ce and Th–Zr, and considerable degree of solubility at moderate temperatures is found in the Th–C system. In connection with this the constitution of ternary alloys Th–Zr–U, and Th–U–C was studied. (auth)

6820 A/CONF.15/P/2044
MECHANICAL PROPERTIES AND CORROSION RESISTANCE OF ZIRCONIUM AND ITS ALLOYS IN WATER, STEAM AND GASES AT ELEVATED TEMPERATURES. R. S. Ambartsumyan, A. A. Kiselev, et al. (U.S.S.R.). 82p.

In the development of commercial alloys, suitable for continuous operation in pressurized water and steam, the following alloys were studied: zirconium–niobium, zirconium–nickel, zirconium–tin, zirconium–iron, zirconium–tantalum, zirconium–niobium–tin, zirconium–niobium–tantalum, zirconium–tin–iron–nickel, zirconium–tin–iron–niobium–nickel, and a number of others. The purity of primary zirconium, following processes of melting and other treatment, as well as the condition of the surface has a profound influence on the properties and on their absolute values. Corrosion tests in water and steam were carried out, mainly under static conditions in distilled water. Corrosion tests in gases were carried out in a glass vacuum apparatus by means of a volumetric method, also in sealed glass capsules with various gases held in thermostatic conditions at the test temperature. Corrosion tests were followed by mechanical testing. The results of corrosion study of alloys in water and steam made it possible to determine alloy groups, which are stable under continuous operation at various temperatures. As a result of research in gases, quantitive data were gathered dealing with the kinetics of interaction with zirconium and its alloys. The change of the mechanical properties of the alloys, when affected by gases, was also obtained. (auth)

6821 A/CONF.15/P/2046
STRUCTURE AND PROPERTIES OF ZIRCONIUM ALLOYS. O. S. Ivanov and V. K. Grigorovich (U.S.S.R.). 34p.

The following properties of binary zirconium alloys were investigated; microstructure, hardness, tensile properties at 20 and 500°C, creep resistance to bending and extention, and corrosion resistance in water at 350 to 400°C. The ternary alloys Cr–Nb–Zr, Cr–Sn–Zr, Mo–Nb–Zr, and Mo–Sn–Zr were also studied. The methods of sampling, heat treatment, and test technique were the same as were used for the binary alloys. (W.D.M.)

6822 A/CONF.15/P/2047
PREPARATION OF DUCTILE ZIRCONIUM BY FUSED SALT ELECTROLYSIS. A. N. Ogarev, V. V. Shentiakov, et al. (U.S.S.R.). 22p.

The technology for the preparation of ductile zirconium metal by fused salt electrolysis is described. Special attention was paid to designing and testing enclosed electrolytic cells suitable for industrial use, as well as to the selection of an electrolyte, electrolysis schedule determination, and development of methods of recovering metal from a cathode deposit, etc. Some 50 compounds were selected and subjected to electrolysis to establish the best suitable electrolyte composition. Several enclosed electrolytic cells providing for an inert atmosphere during the procedure were designed and tested. The effects of temperatures, the basic salt concentration in the electrolyte, current density, duration of cathode deposit growth, and the effects of other factors on the current efficiency and on the quality of the zirconium prepared were studied in detail. The optimum electrolysis schedule was established on the basis of the data obtained. A method of washing the metal with water to eliminate salts was studied. An apparatus specially designed for the purpose was used for washing the metal of the cathode deposit which considerably simplified this process and permitted the preparation of purer metal. Data on chemical, spectral, and sieve analyses of the end metal product and initial salt are given. They show that during the electrolysis zirconium is purified from a number of elements. (auth)

6823 A/CONF.15/P/2048
MELTING AND CASTING OF BERYLLIUM. E. S. Ivanov and V. M. Shmelev (U.S.S.R.). 12p.

The technology of fabricating beryllium items by casting has been studied and developed in the USSR. The principle of combining vacuum melting and centrifugal casting of beryllium is described. The metal is induction melted. The vacuum is set up in the system by a booster and four vacuum pumps. Heating is effected without stopping the pumping. Moisture and the gases

adsorbed by the charge are removed during this period. The furnace is then filled with chemically pure argon. After the temperature of discharge is reached, the metal is poured into a mold through an opening in the bottom of the crucible without loss of vacuum. When centrifugal casting is employed, the rotation rate of the mold is calculated so that a casting with a minimum difference in the thickness of the walls is obtained. (auth)

6824 A/CONF.15/P/2049
SOME PROBLEMS OF WORKING ZIRCONIUM AND ITS ALLOYS. A. A. Kiselev, I. D. Nikitin, et al. (U.S.S.R.). 29p.

Data on the extrusion, rolling, drawing, and other kinds of machining of Zr and its alloys are presented. The use of protective and lubricating films while machining zirconium is shown to be reasonable. Data are given concerning the effect of deformation on the extrusion stress. The effect of deformation on the drawing stress and force, as well as on the coefficient of margin, when drawing products made of zirconium alloys is considered. A study was made of the effect of preliminary deformation on the tensile strength and the reduction of the cross section of some zirconium alloys. A study was also made of the effect of environment, temperature, and time of annealing on the mechanical properties and the grain size of strained zirconium. Annealing zirconium in the air at certain temperatures does not practically deteriorate its mechanical properties compared with annealing in a vacuum. Curves are given pointing to changes in the mechanical properties resulting from the temperature and annealing time for zirconium of various origins. (auth)

6825 A/CONF.15/P/2053
ROD FUEL ELEMENT FOR GAS-COOLED HEAVY-WATER POWER REACTOR. P. I. Christenko, P. A. Petrov, et al. (U.S.S.R.). 24p.

The fuel element consists of a bunch of thin uranium pins. Each pin has a protective sheath made of Mg–Be alloy. The bunch of pins is placed in a tube made of Mg alloy. The radiation growth of U is eliminated by tempering the pin in the beta phase. Buckling of the pins is eliminated by load annealing in the vertical position. Canning of the pin ends is accomplished by welding steel tips, which simultaneously serve to mount the pins. (W.L.H.)

6826 A/CONF.15/P/2054
ELECTRON DIFFRACTION AND KINETIC INVESTIGATIONS OF THE REACTIONS OF OXIDATION OF ZIRCONIUM AND SOME OF ITS ALLOYS. I. I. Korobkov, D. V. Ignatov, et al. (U.S.S.R.). 24p.

The processes of oxidation of zirconium and zirconium-base alloys in oxygen and air at temperatures up to 800°C were investigated. Electronographic analysis of oxidation of thin layers of zirconium helped establish polymorphism of ZrO_2 and temperature regions of existence of various modifications: cubic at 250 to 700°C; tetragonal at 700 to 900°C; and monoclinic over 1000°C. The same structural transformations were also disclosed in the oxide film on massive samples of zirconium. Kinetic examination of zirconium proved that the speed of oxidation increases abruptly during polymorphic transformations of the film of ZrO_2. It was observed that stresses in the oxide film play an important part in changing its structure. (auth)

6827 A/CONF.15/P/2055
MEKHANICHESKIE SVOISTVA DVOINYKH I TROINYKH SPLAVOV TSIRKONIYA S TANTALOM I NIOBIUM PRI KOMNATNOI I POVYSHENNYKH TEMPERATURAKH. (Binary and Ternary Alloys of Zirconium with Tantalum and Niobium). V. S. Emel'yanov, Yu. G. Godin, and A. I. Evstyukhin (U.S.S.R.). 15p.

The results of investigations of a binary system of Zr–Ta by metallography, thermal analysis, measurements of electrical resistance, and x-ray phase analysis are presented. The results of analyzing the zirconium angle of the ternary system Zr–Ta–Nb which possesses a limited solubility of tantalum in β-zirconium, complete solubility of niobium in β-zirconium with eutectoid decay of a β-solid solution, and eutectoid equilibrium $\beta \rightleftharpoons \alpha + \gamma$ between β- and α-zirconium are outlined. A study was also made of the solubility of niobium in α-zirconium, the temperature of eutectoid decay, and the position of the eutectoid point in the system Zr–Nb. The results of studying the mechanical properties of binary and ternary alloys of zirconium with tantalum and niobium are presented. Measurements were taken of the hardness of cast and hardened alloys after they had been isothermally annealed at room temperature and of annealed alloys at higher (up to 700°C) temperatures. A study was made of the effect of thermal treatment on the strength of binary alloys of zirconium with tantalum and niobium and on the strength of ternary alloys at 350°C. Conclusions were drawn regarding the influence of tantalum and niobium on the mechanical properties of zirconium at room and higher temperatures. (auth)

6828 A/CONF.15/P/2120
THE PRESENT STATE OF THE UTILIZATION OF RADIOACTIVE ISOTOPES FOR THE NONDESTRUCTIVE TESTING OF MATERIALS IN CZECHOSLOVAKIA. M. Baimler (Czechoslovakia). 30p.

A brief survey is presented of applications of radioisotopes for non-destructive materials testing. Principal radioisotopes used include cobalt-60, iridium-192, cesium-137, and thulium-170. Applications described include the testing of castings, steel thickness measurements, the testing of large-sized tubes by radiography through one wall, boiler tube testing, and the testing of welds and welded structures. (C.H.)

6829 A/CONF.15/P/2153
MAGNESIUM–BERYLLIUM ALLOYS AS MATERIAL FOR NUCLEAR REACTORS. K. D. Sinelnikov, V. E. Ivanov, and V. F. Zelenskii (Zelensky) (U.S.S.R.). 20p.

Beryllium–magnesium alloys have been investigated as corrosion-resistant cladding for use on reactor fuel elements. The preparation of Be–Mg alloys with a fairly high percentage of Be has been worked out. The cladding of uranium shapes is discussed. The properties, including oxidation and corrosion behavior, of the alloy are given. (W.D.M.)

6830 A/CONF.15/P/2190
EFFECT OF THERMAL CYCLING ON DIMENSIONAL AND STRUCTURAL STABILITY OF VARIOUS METALS AND ALLOYS. A. A. Bochvar, A. A. Gulkova, et al. (U.S.S.R.). 38p.

Studies are reported on the effect of thermal cycling on the dimensional and structural stability of Al, Cu, Ni, Zn, U, Armcoiron, Alpax, Cu–Zn and Al–Zn alloys, carbon steel, and a number of creep-resistant alloys. Composition and structure of alloys, type of space lattice, and thermal cycle variable were also investigated as to their influence on the thermal cycling effects. (W.L.H.)

6831 A/CONF.15/P/2193
DVOINYE DIAGRAMMY SOSTOYANIYA: $UO_2-Al_2O_3$, UO_2-BeO, UO_2-MgO. (Binary Phase Diagrams: $UO_2-Al_2O_3$, UO_2-BeO, UO_2-MgO.) P. P. Budnikov, S. G. Tresvyatskii, and V. I. Kushakovskii (U.S.S.R.). 24p.

The interactions between uranium oxides and alumina, beryllia, and magnesia were studied, and binary phase diagrams were plotted. The systems were investigated using quenching techniques with subsequent x-ray diffraction, microstructural, and chemical analyses of the quenched samples. The investigation of uranium dioxide with alumina and beryllia was additionally carried out by high-temperature thermoanalysis with tungsten–molybdenum thermocouples. Earlier results obtained by investigation of the system by the melting cone method were used for plotting the phase diagram of the uranium dioxide–beryllia system. The investigation resulted in phase diagrams for the systems, which proved to be simple euctetic ones. Solid solutions were found in the UO_2-MgO system whose formation may be accounted for by the effect of excess oxygen. (auth)

6832 A/CONF.15/P/2194
ON THE CORROSION RESISTANCE OF SOME MATERIALS IN SODIUM AND LITHIUM. V. S. Lyashenko, V. V. Zotov, et al. (U.S.S.R.). 28p.

The results of investigation of corrosion of steels in the flow of sodium contaminated with oxygen are presented. It was found that strength of many steels increases almost in the same degree while their relative elongation decreases differently. The erosion resistance of cylindrical samples of various steels and nickel when heated in sodium was also studied. In addition the results of investigation of corrosion resistance of certain steels and pure metals in lithium under static conditions are presented. It was found that carbon steels with 0.06 to 0.7% carbon content are unstable due to the carbon transfer from steel to lithium. The ductility of carbon steels after their holding for a certain time in lithium has been found to decrease sharply. Preferential corrosion of the steels high in carbon is observed. It was proved that steels containing chromium, tungsten, niobium, and molybdenum resist corrosive interaction with lithium more effectively. (auth)

6833 A/CONF.15/P/2197
VZAIMODEISTVIE PLUTONIYA S DRUGIMI METALLAMI V SVYAZI S IKH RASPOLOZHENIEM V PERIODICHESKOI SISTEME D. I. MENDELEEVA. (Interactions Between Plutonium and Other Metals in Connection with Their Arrangement in Mendeleev's Periodic Table.) A. A. Bochvar, S. T. Konobeevskii, et al. (U.S.S.R.). 22p.

Some general characteristics deduced from the study of the interaction between plutonium and other metals are considered. It is pointed out that plutonium does not interact with alkali and alkaline earth elements. Plutonium combines with the metals of the Ia and IIa subgroups of the periodic table to form a number of compounds. Plutonium and the elements of Group III are found to form solid solutions on the basis of ϵ and δ phases. The solubility of elements in plutonium is associated with their arrangement in the periodic table. Plutonium forms a number of compounds with the metals of groups IV and V. The study of interactions between plutonium and metals of the transition groups shows that plutonium combines with the transition elements to form solid solutions on the basis of ϵ and δ phases. In alloying plutonium with elements of groups V and VII of the transition metals, the ability to form solid solutions decreases, whereas the ability to form intermetallic compounds increases. The phase diagrams of plutonium with copper, beryllium, aluminum, lead, bismuth, zirconium, chromium, iron, molybdenum, osmium, thorium, and uranium are given. (auth)

6834 A/CONF.15/P/2218
PRIMENENIE RADIOAKTIVNYKH IZOTOPOV DLYA ISSLEDOVANIYA METALLURGICHESKIKH PROTSESSOV. (Application of Radioactive Isotopes for the Investigation of Metallurgical Processes.) N. G. Bogdanova, P. L. Gruzin, et al. (U.S.S.R.). 17p.

To study the stirring of steel in ladles and open-hearth furnaces, the radioactive isotopes P^{32}, Ir^{192}, Fe^{59}, Cr^{51}, and Co^{60} were used. The velocity of the diffusion of radioactive tracers in the steel bath is determined by the character of the motion of metal. The results of radiometric measurements on metal samples help to determine the time necessary for uniform distribution of the elements throughout the bath and to map the circulating flows of liquid steel. (W.L.H.)

6835 A/CONF.15/P/2230
NEKOTORYE FIZICHESKIE SVOISTVA URANA, PLUTONIYA I IKH SPLAVOV. (Some Physical Properties of Uranium, Plutonium and their Alloys.) S. T. Konobeevskii (Konobeevsky), A. S. Zaimovskii (Zaimovsky), B. M. Levitskii (Levitsky), et al. (U.S.S.R.). 34p.

Data are given on the phase transformation heat of plutonium and on its latent heat of fusion. The results of investigations of the paramagnetic susceptibility of uranium and plutonium alloys with Co, Ni, Mn, Zr, Be, Al, and Fe are reported. The physical properties of metallic uranium were studied. The structure and physical properties of Mo–U alloys were studied and the equilibrium diagram is given. (J.S.R.)

6836 A/CONF.15/P/2236
IZUCHENIE PERERASPREDELENIYA ELEMENTOV V METALLICHESKIKH SPALAVAKH I SVARNYKH SOEDINENIYAKH METODAMI AVTORADIOGRAFII I RADIOMETRII. (A Study on Re-distribution of Elements in Metal Alloys and Weld Joints by Radiography and Radiometry.) B. I. Bruk, A. S. Zav'yalov, and G. I. Kapyrin (U.S.S.R.). 29p.

C^{14} was used to study the distribution of microscopically invisible impurities of carbon in iron alloys and to investigate the distribution of Cr, Mn, Ni, Mo, Si, W, and P. The differences in the bonding forces of the atoms of these elements with the atoms of carbon were used to measure the distribution. It was shown that in alloys of iron with these elements the carbon distribution after tempering is uniform with respect to intergranular boundaries. A formula was derived which helps to determine the minimum thickness of a layer enriched by the element investigated, the layer giving a distinct radiographic picture. Radiographic investigations of the distribution of hydrogen in Ti and Zr were made using tritium. By the use of radioisotopes it was possible to ascertain a complete balance of transition of Cr from the metal, welding rod, and plating into the metal of a joint and into slag when welding zirconium–nickel stainless steel. (J.S.R.)

6837 A/CONF.15/P/2240
THE USE OF RADIOACTIVE ISOTOPES IN THE IN-

SPECTION OF THE TECHNOLOGY OF THE CONTINUOUS CASTING PROCESS. Charles Varga and Joseph Fodor (CSEPEL Works, Budapest). 8p.

A method is described by means of which the depth and the profile curve of the liquid zone was determined for a continuous casting process by using radioactive isotopes. The depth of the liquid zone was determined by preparing a tungsten ball of 20 mm diameter, in the center of which about 10 mc of Co^{60} was placed. During casting this tungsten ball with Co^{60} tracer was thrown into the liquid billet. It sank after being thrown into the still liquid zone until the deepest point was reached. After the billet cooled down, the radioactive body was traced inside the billet, and this point was marked. The length of the billet with full cross section being known, the depth of the liquid zone was then calculated. The plotting of the profile curve of the liquid zone was performed by using P^{32} isotope as a tracer. Several preparations of elementary red phosphorus were made up to a total quantity of 100 mc. The radioactive material was placed inside lead balls in amounts of 25 mc each. The lead balls were threaded at equal spaces on a 5 mm steel rod of 2 m length. During the casting process the rod was pushed into the liquid zone where the lead smelted and the P^{32} isotope, owing to its high mixing velocity, polluted the liquid zone. The solid zone already formed up to the moment of introduction could not be polluted since mixing and diffusion rates for the solid phase are lower by several orders of magnitude. After cooling, the billet was cut lengthwise. The cut surface was machined to smooth finish, and then an autoradiograph was taken by means of which the profile curve of the liquid zone could be plotted. (auth)

6838 A/CONF.15/P/2241

DETERMINATION OF THE TUNGSTEN CONTENT OF ALLOY STEELS BY MEANS OF BETA-GAMMA BACKSCATTERING. Joseph Fodor (CSEPEL Works, Budapest). 14p.

For the determination of the tungsten content in steels, an electromagnetic radiation released by the beta radiation of Tl^{204} was used. The Tl^{204} preparation, made for this purpose, has a toroidal shape, and its active surface is formed so that the greatest part of the radiation reflected by the reflecting surface returns within the torus itself. The spectrum of the electromagnetic radiation reflected by the tungsten steel was measured by a scintillation counter. Choosing, by means of a discriminator, a line characteristic to tungsten content the authors have found that the intensity of the back-reflected radiation varies proportionally to the tungsten content of the alloy. A series of tungsten alloy reference standards was made for measurements at 0 to 20%, the tungsten content of the standards having been checked by chemical and activation analysis. According to comparative measurements the method proposed by the authors has a lower accuracy, for tungsten contents up to 4%, while above 4% it attains the accuracy of the chemical analysis. (auth)

6839 A/CONF.15/P/2255

GRAPHITE FOR NUCLEAR REACTORS. MANUFACTURING FACILITIES IN PORTUGAL. Chagas Roquette (Companhia Portuguesa de Fornos Eléctricos, Portugal). 4p.

The manufacturing facilities for producing nuclear-grade graphite are discussed, based on the equipment, means of research, and working conditions of the industry. (auth)

6840 A/CONF.15/P/2307

VLIYANIE TEKHNOLOGII IZGOTOVLENIYA NA STRUKTURY I SVOISTVA URANA. (Influence of Fabrication on Structure and Properties of Uranium.) G. Ya. Sergeev, V. V. Titova, Z. P. Nikolaeva, A. M. Kaptel'tsev, and L. I. Kolobneva (U.S.S.R.). 33p.

The report describes the results obtained from the investigation of changes in the structure and mechanical properties of cast and hot-rolled uranium by quenching as well as by deformation and annealing at the α phase temperatures. Data are given on the macro- and microstructures of cast and hot-rolled uranium and its mechanical properties which were determined in a wide temperature range, both in short and prolonged testing. Quenching from the β and γ phases is shown to lead to a sharp change in the uranium structure. The investigation of the microstructure of uranium rolled and annealed in the α phase resulted in defining the basic recrystallization characteristics and in plotting approximate recrystallization diagrams. The presence of avalanche twinning during the deformation of textured uranium is shown experimentally. Results are given of investigations of the anisotropy of textured uranium mechanical properties. (auth)

6841 A/CONF.15/P/2368

SINTERING UO_2 AT MEDIUM TEMPERATURE. J. Terraza, J. Cerrolaza, and E. Aparicio (Junta de Energia Nuclear, Madrid). 15p.

The possibility of obtaining a high density in UO_2 at medium temperatures by sintering in vacuum using water as an agglomerate was examined. Sintered products with an apparent density of 10.43 g/cm^3 were obtained by heating in a vacuum at 1200°C. Sintering began at 800°C and up to 1200°C the sintering rate increased with the temperature. For sintering times of about three hours, the optimum pressure ranges between 1275 and 2550 kg/cm^2 which shifts toward the upper limit as the temperature goes up. (W.D.M.)

PARTICLE ACCELERATORS AND HIGH-VOLTAGE MACHINES

6842 A/CONF.15/P/59

THE DESIGN OF A HIGH INTENSITY PULSED SOURCE USING A NEUTRON BOOSTER TARGET. M. J. Poole and E. R. Wiblin, eds. (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 45p.

The new pulsed neutron source erected at Harwell for time of flight experiments is described. It is based on a 28 Mev linear electron accelerator and utilizes a multiplying target of U^{235}. The instantaneous neutron output is enhanced by a factor about 5000. At the same time the effective neutron pulse width has been reduced by a factor of about 3. The absolute value of the instantaneous neutron output (5×10^{17} per sec in the pulse) will set up a flux in the target moderator several times greater than 10^{14} neutrons/cm^2/sec. The considerations leading to the choice of this accelerator and target design are discussed in relation to the electronic techniques available for time of flight experiments and to the pulse distortion inherent in the use of a multiplying target. The theory of this distortion is described. Measurements of the resolution function obtained using the booster are compared with the theoretical values. Some experimental cross section results are quoted together with measurements of reactor lattice spectra. The

latter obtained simultaneously with the cross section results by means of a beam deflection technique in connection with a separate neutron generating target. (auth)

6843 A/CONF.15/P/62
TECHNICAL ASPECTS OF HIGH CURRENT ELECTRON PULSE GENERATOR. J. W. Boag (Mount Vernon Hospital, Northwood, Middx., Eng.) and C. W. Miller (Metropolitan-Vickers Electrical Co. Ltd., Manchester, Eng.). 24p.

The electron accelerator described was designed for studies on the biological and chemical effects of ionizing radiations. It was desired to deliver large doses of radiation within a few microseconds to permit kinetic studies of the temporary products formed. The design criterion was, therefore, maximum electron current at an energy of about 1 Mev or more. The power source available was a 10 cm 2 megawatt magnetron as used on the 4 Mev linear accelerators built for x-ray therapy, but the corrugated waveguide and the electron gun were redesigned for high current. Since the new design permitted about 75% of the input power to be transferred to the electron beam in a single transit through the corrugated guide, feedback proved unnecessary, and the excess power was fed into a water load. At maximum current, which has exceeded 0.5 ampere on test, the energy of the emerging electrons is about 1.5 Mev and, at low current, the electron energy rises to about 2.4 Mev. (auth)

6844 A/CONF.15/P/1374
THE 1100 Mev ELECTRONSYNCHROTRON OF THE NATIONAL LABORATORIES OF FRASCATI. PRESENT STATE OF WORK AND SCIENTIFIC PROGRAM. M. Ageno, A. Alberigi, F. Amman, et al. 32p.

The development, design, and construction of the 1100 Mev electron synchrotron at the National Laboratories in Frascati are summarized. The vacuum chamber problem, experimental equipment, and auxiliaries are described. (W.D.M.)

6845 A/CONF.15/P/1521
HIGH ENERGY MACHINE PHYSICS IN BRITAIN. H. W. B. Skinner (Univ. of Liverpool). 29p.

The synchrocyclotrons at Harwell (180 Mev), Birmingham (1,000 Mev), and Liverpool (380 Mev) and the electron synchrotron (300 Mev) at Glasgow are described and some of the background given. Various highlights in the work done by these machines in recent years are discussed under the headings of strong and weak interactions, cloud and bubble chamber experiments, and miscellaneous work. Examples of experiments described are: work on p-p and π-p scattering, work on the direction of the electron emitted in π and μ beta decay and the circular polarization of the bremsstrahlung produced by these decay electrons, and an experiment on muon induced fusion. (W.D.M.)

6846 A/CONF.15/P/2229
O ZAPUSKE SINKHROFAZOTRONA NA 10 BEV I PERVYKH RESUL'TATAKH FIZICHESKIKH ISSLEDOVANII. (Start Up of 10^9eV Proton Synchrotron at the Joint Institute for Nuclear Research and the Results of Investigations.) V. I. Veksler (U.S.S.R.). 26p.

The results obtained from starting and adjusting the 10^9 ev proton synchrotron at the Joint Institute for Nuclear Research are summarized. Results of the first set of physical experiments made with this accelerator are given. (auth)

6847 A/CONF.15/P/2306
SAMODIFFUZIYA URANA V γ-FAZE. (γ-Uranium Self-Diffusion.) A. A. Bochvar, V. G. Kuznetsova, and V. S. Sergeev (U.S.S.R.). 12p.

The self-diffusion of uranium was studied by the measurement of the diffusion of U^{233} into U^{238}. The concentration of U^{233} in a diffusion layer was determined by measuring the intensity of the alpha radiation. The maximum depth of U^{233} penetration at various temperatures was determined. The successive layer analysis gave a diffusion coefficient of $D = 1.17 \times 10^{-3}$ $\exp(-26600/RT)$ cm^2sec^{-1}, and the autoradiography method gave $D = 1.4 \times 10^{-4}$ $\exp(-21000/RT)$ cm^2sec^{-1}. (J.S.R.)

PHYSICS AND MATHEMATICS

General

6848 A/CONF.15/P/7
RARE EARTH FISSION PRODUCT YIELDS FROM HIGHLY IRRADIATED PLUTONIUM 239. E. A. C. Crouch and I. G. Swainbank (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 11p.

The rare earth fission products were isolated from the products of the irradiation of Pu^{239} with a total dose of 2.3×10^{22} neutrons/cm^2. The rare earths, after separations from the transuranic elements, were themselves separated by means of a micro cation-exchange column, and the isotopic composition and absolute quantity of each element determined by mass spectrometry and micro-chelatometry, or by neutron activation analysis. The isotopes estimated were La^{139}, Ce^{140}, Ce^{142}, Ce^{144}, Pr^{141}, Nd^{142}, Nd^{143}, Nd^{144}, Nd^{145}, Nd^{146}, Nd^{148}, Nd^{150}, Sm^{147}, Sm^{148}, Sm^{150}, Sm^{151}, Sm^{152}, Sm^{154}, Eu^{152}, Eu^{153}, Eu^{154}, Eu^{155}, Gd^{156}, Gd^{158}, Gd^{160}. The isotopes Tb^{159}, Dy^{160}, Dy^{162}, Dy^{163}, Dy^{164} were also found to be present but were not estimated. (auth)

6849 A/CONF.15/P/143
THERMAL CONDUCTIVITIES OF MIXTURES OF FISSION PRODUCT GASES WITH HELIUM AND WITH ARGON. H. von Ubisch, S. Hall, and R. Srivastav (AB Atomenergi, Stockholm). 11p.

Fuel elements consisting of canned UO_2 may also contain some helium in order to improve the heat transfer within the element. As burn-up proceeds, fission product gases mix into the helium and lower the heat conductivity of the gas. Thermal conductivities of all binary mixtures of the common rare gases and of the ternary system He–Kr–Xe over the whole concentration range were measured by means of the hot-wire method. In addition, results were compared with calculations performed by means of the Enskog-Chapman theory for nonuniform gases. As a result graphs were obtained showing the thermal conductivities of fission product gases (in this case 15.8% Kr and 84.2% Xe) and mixed with helium or argon over the whole range of concentrations. The valid temperature range is from room temperature to about 1000°C. (auth)

6850 A/CONF.15/P/153
ON THE TIME ENERGY DISTRIBUTION OF SLOWED DOWN NEUTRONS. Ivar Waller (Univ. of Uppsala). 7p.

An account is given of the work done on the time-energy distribution in a moderator of neutrons emitted with a definite energy at a certain instant. An exact

solution of the problem is given in closed form. (L.T.W.)

6851 A/CONF.15/P/154
ON THE SCATTERING OF SLOW NEUTRONS BY HYDROGEN MOLECULES. Stig Brimberg (ASEA, Västerås, Sweden). 47p.

A complete quantum mechanical description of the scattering of slow neutrons by ortho-1 and parahydrogen molecules is presented. A detailed numerical evaluation of theoretical formulas is obtained for comparison with available experimental values of the scattering cross section at different neutron energies. (auth)

6852 A/CONF.15/P/196
AN INVESTIGATION OF TIME-REVERSAL INVARIANCE IN THE BETA DECAY OF THE NEUTRON. M. A. Clark and J. M. Robson (Atomic Energy of Canada Ltd., Chalk River, Ont.), and R. Nathans (Pennsylvania State Univ., University Park; and Brookhaven National Lab., Upton, N. Y.). 10p. (AECL-606). $0.25(AECL).

Violation of time-reversal invariance in the beta decay of the neutron should give an asymmetry in the number of electrons emitted on each side of the proton-recoil direction in a plane perpendicular to the direction of polarization of the neutron. A horizontal beam of neutrons from the NRX reactor at Chalk River is partially polarized by transmission through a magnetized block of cold-rolled steel. The total thermal-neutron intensity in the beam after transmission through 25 mm of steel is 8×10^8 neutrons per second in a diameter of 32 mm. Its measured polarization is about 40 per cent with the direction of polarization within 5° of the vertical. This beam passes through a large evacuated tank where the protons from a 3 cm length of beam recoiling into a 10° cone about a line perpendicular to both the beam direction and the polarization direction are detected by an electron multiplier. Two electron counters are used with their axes 160° on each side of the mean direction for detection of protons. The axes of the electron counters and the proton counter are all in the horizontal plane so that $J.(p_e \times p_\gamma)$ has the same absolute magnitude but opposite sign for coincidences between the proton counter and the two electron counters. The electron counters are both 12.7 cm-diameter plastic scintillation counters and are located 38 cm from the region of the neutron beam from which the electron multiplier can detect protons. With this geometric arrangement the asymmetries $J.p_e$ and $J.p_\gamma$ due to parity nonconservation will be zero and will not obscure the time-reversal asymmetry. Coincidences have been detected and have been established as due to neutron-decay events. Their rate is consistent with the known half life of the neutron. The asymmetry between the two directions is being determined by measuring the coincidence rates for neutrons polarized and for neutrons unpolarized. In both cases an auxiliary magnetic guide field is applied to keep the neutron spins vertical. The experiment is severely limited by the high background inherent in using the transmission method of polarization on a direct beam from a reactor. The results to date give $D = 0 \pm 0.5$ which is consistent with both time-reversal invariance or the converse. (auth)

6853 A/CONF.15/P/205
LONG IRRADIATION OF NATURAL URANIUM. D. S. Craig, G. C. Hanna, et al. (Atomic Energy of Canada Ltd., Chalk River, Ont.). 34p. (AECL-615). $0.25 (AECL).

The principal factors controlling the change of reactivity with irradiation are the destruction of U^{235}, the production of Pu^{239} and higher plutonium isotopes, and the accumulation of fission products. Cross sections appropriate to reactor neutron spectra were calculated from basic nuclear data. With increased irradiation, changes in the neutron spectrum in the fuel result from self-shielding in the resonance region and increased thermal neutron absorption cross section. The fission-product absorption cross section of irradiated fuel can be closely simulated by using three pseudo fission products with cross sections of 600, 300, and 25 barns. Measurements were made of the spatial distribution of U^{235}, plutonium isotopes, and Cs^{137} in an NRX rod irradiated to 3000 Mwd/ton. Precise mass-spectrometer analyses of the uranium and plutonium isotopes combined with chemical analyses for plutonium gave accurate values of the conversion factor and the effective capture cross sections of the plutonium isotopes. These results have been satisfactorily reconciled with the basic nuclear data and the calculated effects of changing neutron spectra. (auth)

6854 A/CONF.15/P/283
RECENT DEVELOPMENTS IN THE USE OF RADIOISOTOPES FOR INDUSTRIAL RESEARCH AND PROCESS CONTROL. J. L. Putman (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 15p.

A résumé of recent advances in uses of isotopes is presented. A gage for measuring the tube wall thicknesses when only the inside is accessible is described. By using a small phosphor, which is preferentially sensitive to low-energy back-scattered radiation, the need for an amplitude analyzer is avoided. Gamma-ray density gages have largely superseded radioactive tracer methods for interface detection in cross-country oil pipe-lines. Density changes as low as 0.1% are detectable. A density gage comprising a cobalt-60 source and a low-voltage halogen-quenched counter, separated by lead, has been developed for measuring densities of earth strata. The performance of a soil moisture gage using a Po—Be source in conjunction with a BF_3 counter has been studied, with particular reference to the effects of slow neutron absorbers, such as boron, chlorine, and manganese, present in some soils. A similar gage is used for checking the drying of concrete. Slow neutron absorption in glass is used as a means of checking its boron content. Bremsstrahlung from tritium sources adsorbed on Zr and Ti has been shown suitable for absorption gages to measure the sulfur content of hydrocarbon fuels down to 0.004%. Alpha particles from a polonium source have been used for the radiography of paper and radioactive tracer investigations on a large scale include the use of radioactive additives to measure bulk flow and recycling in cement, fertilizer, and glass factories. (auth)

6855 A/CONF.15/P/285
APPLICATIONS OF FLUORESCENT X-RAY PRODUCTION BY ELECTRON CAPTURE ISOTOPES. G. B. Cook, C. E. Mellish, and J. A. Payne (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 14p.

The possibility, of making a simple apparatus for x-ray fluorescence spectroscopy by using a radioactive source to replace the x-ray tube and an electronic counter that can discriminate between x rays of differ-

ent energy to replace the crystal spectrometer, is investigated. By this dual substitution the radiation output required from the exciting source can be decreased from about 104 curies to about 60 μcuries, because of the more favorable geometrical arrangements which are possible. (W.D.M.)

6856 A/CONF.15/P/478
URANIUM LOADED PHOTONUCLEAR EMULSIONS USED FOR DETECTION OF THERMAL NEUTRONS. M. Jurić, I. Petrović, et al. (Inst. of Nuclear Sciences "Boris Kidrič," Belgrade). 8p.

The methods of loading of nuclear plates by immersion of plates in U solution and of mixing of U solutions with the emulsion in gel form are compared. The characteristics of registration of alpha particle and fission particle tracks are investigated for loaded emulsion in gel form of various concentration of uranium. The best condition of preparation of emulsion in gel form for neutron flux measurement purposes was found. (auth)

6857 A/CONF.15/P/566
ABSOLUTE MEASUREMENT OF FAST NEUTRON FLUX BY γ–COUNTING BY (n,α), (n,p) AND (n,n') REACTION PRODUCTS. H. Ager-Hanssen and J. M. Dyderlein (Joint Establishment for Nuclear Energy Research, Kjeller, Norway). 10p.

The measurement of fast neutron flux by threshold reactions has always been based on a determination of the absolute β-activity of the reaction product. Due to the self-shielding of the β-particles in the sample, this method limits the sample thickness which can be used to a few mg/cm^2. We have found that in the few cases where the decay of the reaction products involves simple gamma transitions, the fast neutron flux can conveniently be obtained from a measurement of the absolute gamma activity. This makes it possible to use a much larger sample, consequently reducing the minimum detectable flux. It has also been found that the fast flux can be measured by exciting a nuclear isomer by inelastic scattering and subsequently, counting the gamma activity corresponding to the isomeric transition. The relatively large cross-section of inelastic scattering makes this reaction advantageous to the (n,p) and (n,α) threshold reactions. Using this technique, we have found that it should be possible to measure fast fluxes at least a factor of 10^4 smaller than what is possible by absolute β-counting. The technique should be very well suited for bulk shielding measurements. (auth)

6858 A/CONF.15/P/578
SCATTERED RADIATION FROM A 1700 CURIES Cs^{137} THERAPY UNIT. Per Grande (Norwegian Radium Hospital, Oslo) and J. L. Haybittle (Addenbrooke's Hospital, Cambridge, Eng.). 16p.

In studying the protection of a 1700-curie Cs^{137} therapy unit, the radiation penetrating the source housing and also the radiation scattered from the beam were measured. The angular distribution of the radiation scattered from the air and from the patient (phantom) was measured for two different field sizes and two different phantom sizes. Investigation of the radiation quality was done by means of lead absorbers surrounding the ionization chamber which had been calibrated beforehand against a radium standard source. The results are compared with those predicted by theory. (auth)

6859 A/CONF.15/P/586
A METHOD FOR THE DETERMINATION OF VERY SMALL AMOUNTS OF I-131 IN BIOLOGICAL MATERIALS, ESPECIALLY IN MILK. Helge Bergh (Forsvarets Forskningsinstitutt, Oslo). 9p.

A new highly sensitive method is described for the determination of very small amount of I-131 in biological materials, especially in milk. The method was tested in an experiment by giving 700 microcurie I-131 as 1 microgram Iodine to a three years old cow. The I-131 secretion in the milk could easily be traced over 32 days. The method has been used in routine analysis of I-131 in milk from different parts of Norway over a year. It is possible with this method to detect less than 1/400 part of the maximum permissible daily intake of I-131 in milk for infants. Higher sensitivity can easily be obtained if desired. (auth)

6860 A/CONF.15/P/965
EXPERIMENTAL PROOF FOR THE VIOLATION OF PARITY CONSERVATION BY MEASURING THE CIRCULAR POLARIZATION OF γ-RAYS. Herwig Schopper (Inst. for Nuclear Physics, Mainz). 19p.

The circular polarization of gamma radiation, which provides a method for proving parity non-conservation, can be measured by scattering on polarized electrons in magnetized iron. Possible experimental arrangements are discussed which include β-γ circular polarization correlation, the circular polarization of external bremsstrahlung and annihilation radiation, and the circular polarization of internal bremsstrahlung. (W.D.M.)

6861 A/CONF.15/P/971
CONCEPTS AND MEASUREMENT OF DOSE. H. Fränz and W. Hübner (Germany). 7p.

In dosimetry the three different concepts of doses used include the absorbed dose with the unit rad, the exposure dose with the unit roentgen, and the relative biological effectiveness which is specified in rem. Applications in practical dosimetry of x and gamma radiation are discussed. (C.H.)

6862 A/CONF.15/P/999
THE INFLUENCE OF METEOROLOGICAL PARAMETERS ON THE PROPAGATION OF RADIOACTIVE FISSION PRODUCTS IN THE BIOSPHERE. Max Hinzpeter (Germany). 17p.

The Deutscher Wetterdienst has established a network of 10 stations which are measuring the long-lived nongaseous beta activity in ground level air and precipitation. First, the results of 1957 are represented in a summarized form. Measuring methods and their respective accuracies are explained. The precipitation is divided into several groups according to intensity. The average quantity of each group contained in the amount of activity going down to the earth's surface in μc per square meter per day is further examined. From the results, conclusions are drawn on the amount of wash-out and the distribution of activity with height. Further, the functional relation between long-life activity in precipitation and that of the ground level air is dealt with. The influence of marked meteorological phenomena (e.g., front-lines and different air masses) on the relation between the activity in the air and precipitation is explained. The paper shows, above all, those relations between meteorological parameters and long-lived radioactivity in the biosphere which are governed by vertical meteorological processes above the measuring station. It is assumed that the distance between the measuring station and the place of origin of the radioactive fission products is always in the order of magnitude of a least 10,000 km's. (auth)

6863 A/CONF.15/P/1104
THE APPLICATION OF INTERNAL LIQUID SCINTILLATION COUNTING TO A 4π-β-γ COINCIDENCE METHOD FOR THE ABSOLUTE STANDARDISATION OF RADIOACTIVE NUCLIDES. J. Steyn and F. Haasbroek (Council for Scientific and Industrial Research, Pretoria). 21p.

A 4π β-γ coincidence method for the absolute standardization of β-emitting isotopes is described. The source is dissolved in a liquid scintillator, and a NaI scintillation counter detects the γ rays. In this way the advantages of both the 4π liquid scintillation counting method and the coincidence method are realized. The solution of a radioisotope in the liquid scintillator fully conforms to the coincidence method requirement that one of the counters should be equally sensitive to all parts of the source. However, since the γ efficiency of the liquid scintillator is by no means insignificant and the β efficiency is always less than 100%, the effect of the γ-ray contribution on the results of the determinations is discussed. Under appropriate conditions the determinations are experimentally shown to be insensitive to γ-ray contributions in the β channel. The following radioisotopes have been standardized by the method under discussion: Co^{60}, Na^{22}, Na^{24}, I^{131}, and Au^{198}. For comparison, 4π β-γ coincidence measurements have also been made with dry sources of these nuclides in a conventional 4π proportional flow counter. Excellent agreement has been obtained. (auth)

6864 A/CONF.15/P/1139
UN NOUVEAU PRINCIPE EN RESONANCE NUCLEAIRE APPLICATIONS. (A New Principle in Nuclear Resonance-Applications). Anatole Abragam (Commissariat à l'Énergie Atomique, Paris). 8p.

It has been shown theoretically by Overhauser and experimentally by Slichter that the application of an intense r-f field at the Larmor frequency of the conduction electrons to a metallic sample would increase the nuclear polarization. This idea was developed both theoretically and experimentally. The application of the r-f field to solutions of paramagnetic substances causes an increase in the nuclear polarization of the solvent of the same order of magnitude as for the metals but with an opposite sign. The saturation of one of the electron resonance spectral lines of peroxylamine sulfonate gives an increase of the proton signal of the order of 40 in high fields of 3000 gauss. In intermediate fields of 100 gauss the proton signal is increased by an order of 80. An apparatus to measure the field of the earth within 10^{-6} gauss was constructed. In a silicon semiconductor the partial saturation of the spin resonance of conduction electrons has resulted in an increase of the polarization of Si^{29} of the order of 1500. (J.S.R.)

6865 A/CONF.15/P/1189
MESURE EXPERIMENTALE DES PARCOURS DES FRAGMENTS DE FISSION DANS L'URANIUM, L'OR, LE ZIRCONIUM ET LE SILICIUM. (Experimental Measurement of Fission Fragment Ranges in Uranium, Gold, Zirconium and Silicon.) Henriette Faraggi and Arlette Garin-Bonnet (Commissariat à l'Énergie Atomique, Paris). 7p.

A method for the measurement of fission fragment ranges in solids is described. The method is based on the fact that the number of particles emitted by the unit surface of a thick material is equal to $\frac{1}{4}$ of the total number of particles emitted within a layer of thickness equal to the range of the particles in the solid itself. Measurements were made on natural uranium and the results are reported. Measurements were also made on U-Zr, Au-U, and Si-U alloys, but the results are not yet available. (J.S.R.)

6866 A/CONF.15/P/1219
THE USE OF SCINTILLOGRAPHY IN MEDICINE. A. Gandy and H. Jammet (Curie Foundation, Paris). 44p.

The aim of the scintillographic method is to obtain from an object with a certain γ activity, a life-sized image on which the differences of radioactive concentration are faithfully reproduced. The instrument which performs these operations consists of a shielded scintillation counter moving above the object, and a recording instrument tracing the image and propelled by a synchronous movement. A mechanical and electronic system allows the numerous variables which occur in the examination to be modified. The result obtained consists of an image on which each stroke corresponds to an impulse. For the scintillogram obtained, the blackening, contrast, resolution power, and blurring can be discussed. The general applications of the scintillographic method in medicine consist in detecting, and then studying, the topographical distribution of radioactive substances introduced into the organism, either in the form of a sealed source or as a free substance. In the former case it is only a question of a topographical and morphological study of the irradiation obtained; in the latter case, the metabolic properties of the γ-emitting radioelement enter into the question, and the morphological examination is accompanied by a functional study of the different parts of an organ or a tissue. Some examples of the application of this method are given. After the insertion of grains of radioactive gold, the relative homogeneity of the irradiation can be estimated by scintillographic examination. In the same way the topographical distribution of colloidal radiogold after intravenous injection is studied; this makes it possible to follow the distribution, often heterogeneous, of the radio-colloid. However, it is in the free internal use of γ-emitting radioactive materials that this method is fully applicable. Iodine-131, used in the form of soluble iodide, is fixed by the thyroid. An image can be obtained of the iodine-fixing activity of the thyroid body; anomalies of position, dimensions, and form can be detected; in particular, neoplasmic degeneration can be precisely observed, and in favorable cases of iodine fixation a clear image of thyroid cancer metastases can be obtained. (auth)

6867 A/CONF.15/P/1222
STUDY OF RADIOACTIVE PHOSPHORUS (P^{32}) DISTRIBUTION IN MAN BY EXTERNAL BREMSSTRAHLUNG MEASUREMENTS. M. Tubiana, P. Albarede, and H. Nahum (Inst. Gustave Roussy, Villejuif, France). 22p.

The range in tissues of beta particles emitted by phosphorus-32 is so short that the study of radiophosphorus distribution in a human organism by external counting methods does not seem valid. It is for this reason that it seemed useful to establish new techniques based on the detection of Bremsstrahlung. By means of a scintillating counter and a single-channel selector it is possible to follow in the human body the radioactivity of different viscera, such as the liver and the spleen, and to compare the uptake in a tumor and neighboring or symmetrical healthy tissues after injecting a dose of not more than 200 microcuries

of radiophosphorus. Preliminary studies with a phantom showed that it is possible to obtain a counting rate per microcurie of radiophosphorus equal to $\frac{1}{20}$ of that which is obtained by the same dose of iodine under the same geometrical conditions. Under the conditions chosen, the radiation measured has physical characteristics similar to those of a 120-Kev gamma radiation. The limits and possibilities of using this method on man are discussed as well as the usefulness it can have for diagnosis and prognostic studies. (C.H.)

6868 A/CONF.15/P/1265
APPLICATION OF GENERAL METHODS OF STUDY OF POROUS BODIES TO THE DETERMINATION OF THE CHARACTERISTICS OF BARRIERS. Jean Charpin, Pierre Plurien, and Simone Mommejac (Commissariat à l'Énergie Atomique, Paris). 20p.

The methods of investigating porous bodies for application in gaseous diffusion plants as barrier material are considered. Comparison of results obtained by methods based on different principles makes possible the definition of the permeability and effective pore radii of prototype barriers. The most direct and rapid method is the measurement of permeability by air. This method is valid only if the results are periodically checked against results obtained by other methods. (auth)

6869 A/CONF.15/P/1285
AN UPPER LIMIT FOR THE VAPOUR PRESSURE OF BISMUTH (ThC) AT ROOM TEMPERATURE. J. S. Auslander, V. Labău, and St. Meitert (Inst. de Physique Atomique, Bucharest). 7p.

By the photographic method developed previously the vapor pressure of bismuth in the form of Bi^{212} is measured at room temperature. The method is improved by use of a cylindrical vessel of large volume, ~1500 liters. (auth)

6870 A/CONF.15/P/1301
L'ETUDE PAR DES METHODES RADIOACTIVES, DE L'INFLUENCE DE LA VISCOSITE SUR L'EPAISSEUR DE LA PELLICULE DE LUBRIFIANT. (The Effect of the Viscosity on Lubricant Film Thickness as Determined by Means of a Radioactive Additive). Dan Pavelescu and Ivan Iliuc (Inst. de Mécanique Appliquée de l'Académie de la R.P.R., Bucharest). 22p.

A study was made of the various factors which affect lubrication, and an attempt was made to analyze the hydrodynamic operation of lubrication. The factors investigated in the present work are the viscosity and the film thickness of the lubricant. A brief survey is made of the results obtained by previous investigators on the relation of viscosity and film thickness. A theoretical relation between these factors is then derived and verified experimentally with the use of radioactive additives. The methods used in the measurement of film thickness are described and the results obtained are given. It was concluded that only when all other factors are constant does the viscosity affect the film thickness directly, and that this effect diminishes in the zone of thin films. (J.S.R.)

6871 A/CONF.15/P/1321
UTILIZATION OF RADIOISOTOPES AND HIGH ENERGY RADIATION IN JAPAN. (Atomic Energy Bureau, Japan). 9p.

Since radioisotopes were imported into Japan for the first time from Oak Ridge National Laboratory in 1950, demands for radioisotopes for research uses have been increasing year after year. The remarkable increase is especially seen in I^{131}, P^{32}, and Au^{198}, and the amounts of their monthly imports are roughly 3,200 mc, 2,500 mc, and 1,800 mc, respectively. The import of Co^{60} as a gamma irradiation source amounted to only 443 curies in 1954, but more than 20,000 curies are expected to be imported in 1958. The number of research projects using radioisotopes was only 139 in 1950, but it amounted to about 3,000 projects in 1956 and is expected to increase to more than 4,000 in 1957. The classification of the research projects made according to the field in which radioisotopes are used shows that 60% of radioisotopes are used in medical science and the rest for physics, chemistry, biology, agriculture, and industry. In medical science, the materials are mostly used for diagnosis and therapy and some of them for research on metabolism, effects of various radiations on the function of organs, blood circulation, and others. (auth)

6872 A/CONF.15/P/1366
POINT IMPERFECTIONS IN THE ALKALI HALIDES. F. G. Fumi (Univ. of Pavia, Italy). 16p.

The experimental and theoretical values of the energies of formation, motion, and association of point imperfections in typical ionic lattices in connection with their role in the transportation of matter in solids are discussed and applied to the alkali halides. (auth)

6873 A/CONF.15/P/1377
SOME INTEGRAL ASPECTS IN THE "AGE" THEORY. S. Albertoni, L. Brusa, and G. Papini (Centro Nazionale per le Ricerche Nucleari, Ispra, Italy). 6p.

Some characteristics of the parabolic age equation, in the space and energy variables, are examined. The simple model used seems to be particularly suitable to a more general formulation of the problem. The thermal fission term is proved to render the parabolic problem, generally with characteristics of propagation, an eigenvalue problem. Moreover, the convergence of a finite difference method is examined with the help of the Rothe method. (auth)

6874 A/CONF.15/P/1378
A ONE DIMENSIONAL TIME SAVING CODE FOR PARAMETRIC STUDIES ON A SLOW DIGITAL COMPUTER, BASED ON MATRIX SCHEME. S. Albertoni, G. Bortone, B. Faleschini, C. Tamagnini (Centro Nazionale per le Ricerche Nucleari, Ispra, Italy). 7p.

Starting from a paper by Ascari, Bortone, and Businaro, based on the analysis of a scheme by Schmid, a code for the parametric study of a two-group, up to six region, spherical reactor is worked out. The code is made for the CRC 102A/P and several facilities are provided for its use. It is possible to assume various geometrical or physical parameters of every region as eigenvalues; i.e., the ratio of fuel to total volume, or the multiplication factor. The fundamental parameters of a reactor design are chosen as "input" data. The coefficients of the two-group diffusion equations are computed starting from these parameters. A second order method was used for the resolution of the critical equation, and the computation of the normalized fluxes was obtained by means of the Runge-Kutta modified method. (auth)

6875 A/CONF.15/P/1467
BODY RADIOACTIVITY MEASUREMENT AS AN AID IN ASSESSING CONTAMINATION BY RADIO-NUCLIDES. J. Rundo (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 28p.

Methods which have been used to measure radioactive

materials within the human body are briefly surveyed. Because of the high efficiency of sodium iodide as a detector of γ-rays, and its powers of energy resolution, an apparatus using crystals of this material was built at AERE, Harwell. The apparatus consists of a substantial lead shield, and the subject lies on a stretcher for the measurement. Four counters (NaI(Tl) crystals, 4-inches in diameter by 2-inches thick) are disposed about the body in such a way as to minimize the effects on sensitivity of different subject weights, and of distribution of the activity in the body. The energy spectrum of the amplified pulses from the counters is determined with a multichannel pulse amplitude analyzer. The natural γ-ray activity of the body limits the sensitivity of measurements of contaminants within the body. This activity is due to potassium−40 and the current contamination with the fission product cesium−137. The mean potassium content of sixteen adult males was 0.21% of body weight with a standard deviation of 0.023%. The mean cesium−137 content of these subjects, measured between June 1956 and July 1957, was 34.0 μμc per g potassium, with a standard deviation of 7.6 μμc per g potassium. For the assessment of internal contamination with a γ-ray emitter at about the same level as this natural activity, or with a pure β-particle emitter via its bremsstrahlung, the background activity must be known or be determinable. Measurements with a phantom have demonstrated the practicability of constructing the shape of the spectrum of the body radiation in particular at low energies. (auth)

6876 A/CONF.15/P/1474

ELECTRICAL CONDUCTIVITY OF URANIUM OXIDES. M. J. Brabers (Joint Establishment for Nuclear Energy Research, Kjeller, Norway). 5p.

Electrical conductivities of sintered uranium oxides in the composition range from O/U = 2.00 to O/U = 2.15 have been measured in argon atmosphere and in the temperature range from 20 to 1000°C. Conductivities have been determined from measurement of the potential drops in the specimen and a calibrated resistor in series with it. (auth)

6877 A/CONF.15/P/1480

THE STRUCTURE OF THE TRITON. M. El-Nadi and L. F. Abou-Hadid (Egyptian Atomic Energy Commission, Cairo). 7p.

One of the interesting applications of the stripping reactions is the possibility of studying the internal structure of the triton. Butler and Salpeter pointed out a method for finding an upper limit for the probability amplitude "A_0" of finding the triton as consisting of a deuteron in the ground state plus another neutron. This was carried out by Werner, who used the results obtained by Rotblat and Holmgren to calculate this upper limit value A_0. It was found that $|A_0|^2$ is less than 0.11, which shows that the probability of the above-mentioned model is very small. Owing to the importance of this point in theoretical calculations, the results of which are reported, the following sets of reactions were chosen: $F^{19}(p,d)F^{18}$; $F^{19}(d,t)F^{18}$; $Li^7(p,d)Li^6$; and $Li^7(d,t)Li^6$. The calculated values of $|A_0|^2$ obtained were found to be very small. For the reactions $F^{19}(p,d)F^{18}$ and $F^{19}(d,t)F^{18}$, $|A_0|^2 = 0.022$, and for the reactions $Li^7(p,d)Li^6$ and $Li^7(d,t)Li^6$, $|A_0|^2 = 0.06$. On the other hand, the ratios of the cross sections $\sigma(d,t)/\sigma(p,d)$ were found to vary linearly with the angle, while for the reaction $C^{12}(p,d)C^{13}$ and $C^{13}(d,t)C^{12}$, Werner found that this ratio is independent of angle. The variation of the theoretical ratios with angle agrees satisfactorily with the experimental ratios. (auth)

6878 A/CONF.15/P/1484

QUANTITATIVE & QUALITATIVE ESTIMATION OF GAMMA RADIATION SCATTERED FROM PROTECTIVE BARRIERS. K. A. Mahmoud (Egyptian Atomic Energy Commission, Cairo). 19p.

Protective barriers against primary and secondary radiation are necessary in x- and γ-ray rooms. As well as absorbing radiations, these barriers inevitably scatter radiation back into the room. Hence it is important to determine the factors which affect quantity and nature of scattered radiation in order to find means to minimize the effects. Investigations on quantity and quality of radiation scattered from lead and concrete walls of density 2.4 g/cm^3 are reported. The effects of covering concrete with lead sheets of different thicknesses was also studied for the energy range 0.085 to 2.76 Mev. (auth)

6879 A/CONF.15/P/1714

A POSSIBILITY OF PREPARING OVERHEATED SOLID STATE IN REACTORS. T. A. Hoffmann (Central Research Inst. for Physics, Budapest). 17p.

In a theoretical calculation of the melting properties of solids, the size of the subcrystallite and the vacancy concentration are related to the energy–entropy diagram of a solid. It is theorized that if the sample is irradiated in a high neutron flux below the melting point to create the critical number of vacancies and the temperature is caused to rise very rapidly above the melting point, then the sample will remain stable without melting. (W.D.M.)

6880 A/CONF.15/P/1730

INVESTIGATIONS ON THE MODERATING PARAMETERS OF "DOWTHERM A" AT DIFFERENT TEMPERATURES. L. Bata, I. Kiss, and L. I. Pál (Central Research Inst. for Physics, Budapest). 23p.

Moderating properties of Dowtherm A consisting of 26.18% diphenyl and 73.19% diphenyl oxide were tested at different temperatures. The temperature dependence of diffusion length was found to obey the empirical relation $L_D = 4.002 \exp(0.0014\ T)$. Slowing down length was found to be $L_S = 11.24 \pm 0.06$ cm at 36°C. (W.D.M.)

6881 A/CONF.15/P/1799

INFLUENCE DES "COLLISIONS DISTANTES" SUR LE PHENOMENE D'AUTO-STRICTION MAGNETIQUE DANS UN ARC. (The Effect of Distant Collisions on the Magnetic Autostriction Observed in an Arc.) Max Hoyaux and Paul Gans (Ateliers de Constructions Electriques, Charlerol, Belgium). 53p.

An attempt is made to establish a theory of the pinching of an arc formed in hydrogen or its isotopes by magnetic autostriction. The Gvosdover effect, the effect of "distant collisions" or electron scatter through the Coulomb microfield of the positive ions, greatly modifies the radial distributions of the ionic and electronic densities and always in the sense of a reduction in the autostriction. This effect, established initially for mercury vapor, is applied to an arc formed in hydrogen or its isotopes. It is shown that to achieve the final conditions of maximum pinch, the initial conditions must be such that the Gvosdover effect is not marked. The direct application of this theory to current experiments, which are characterized by a very high dI/dt, requires that the dynamic phenomena be considered. The study was made for the case of vanishing Gvosdover effect and of extreme Gvosdover effect by considering the term of time evolution as a perturbation. (J.S.R.)

6882 A/CONF.15/P/1804
NEUTRONIC CONDUCTORS. J. Ortega Costa (Escuela de Ingenieros Industriales, Barcelona). 16p.

Starting from an analogy between neutron scattering and the distribution of electrical potential in a geometric volume, the concept of a neutron conductor is developed. It is characterized by its own resistance and capacity. The use of some characteristic circuits leads to simplified formulas for the computation of thermal utilization in an heterogeneous lattice of the type $1/f = 1 + C_1/C_8 + \alpha C_1 R_1$, where C_1 and R_1 are the capacity and resistance of the moderator and C_8 the fuel capacity. By adding an additional capacity, it is possible to make an evaluation of the influence of the cartridge in the expression for thermal utilization, by introducing the factor $\gamma = 1 + C_v/C_8$ in which C_v is the neutron capacity of the cartridge. Various examples of the computations are presented, and the results are compared with published experimental data. (auth)

6883 A/CONF.15/P/1827
A SUBCRITICAL CIRCULATING SUSPENSION REACTOR. K. J. de Jong, J. A. H. Kersten, J. J. Went, H. H. Woldringh, and J. J. van Zolingen (RCN-KEMA Reactor Development Group, Arnhem, Netherlands). 7p.

The construction of a subcritical circulating suspension assembly is described. It enables rapid changes in the uranium oxide concentration, continuous determination of the concentration, and temperature control within 0.05 to 80°C. With a hydrocyclone the fuel can be removed rapidly from the reactor circuit. The total recovery of the fuel from the system is better than 99.5%. Operational experience is discussed. An accelerator tube is used as an external neutron source, and for measuring fluctuations fission counters with fast discriminating counting units up to 6 decades are used. (W.D.M.)

6884 A/CONF.15/P/1950
THERMAL NEUTRON DISTRIBUTIONS DUE TO TIME DEPENDENT FAST NEUTRON SOURCES IN MULTIPLYING MEDIA. S. B. D. Iyengar and G. S. Mani (Atomic Energy Establishment, Trombay, India). 10p.

The distribution of thermal neutrons in a multiplying medium due to a time-dependent fast neutron source was investigated theoretically. This was done using the "symbolic operator" formulation. Explicit solutions were obtained on the age and two group approximations both for an infinite geometry and for a finite geometry. The expressions were derived both with and without taking account of the delayed neutrons. The multiplication factor for multiplying media can be determined by means of pulsed neutron experiments, using these expressions. This might be particularly useful when only small quantities of fuel and moderator are available for experiments. (auth)

6885 A/CONF.15/P/1972
OBSERVATION ON THE WEAK NORDHEIM RULE AND ON ISOMERISM IN ODD-ODD NUCLEI. C. A. Mallmann (Comisión Nacional de Energía Atómica, Buenos Aires). 5p.

It is shown that agreement between the experimental findings and the Nordheim weak rule is improved, provided the rule is written as $|j_\pi - j_\nu| \leq J \leq j_\pi + j_\nu$, with $j_\pi + j_\nu + l_\pi + l_\nu$ = an odd integer. It is further shown that there appears to be no preference for any of the spins forecast by application of the rule. The observations of M. Goldhaber on isomerism in odd-odd nuclides are explained, namely, the absence of a relationship between isomers and magic numbers and the absence of any preference for changes in pairing. (auth)

6886 A/CONF.15/P/2023
THE DETERMINATION OF TRACE IMPURITIES IN PURE MATERIALS BY THE RADIOACTIVATION ANALYSIS. Y. V. Yakovlev, A. I. Kulak, V. A. Ryabukhin, and R. S. Rytchkov (U.S.S.R.) 32p.

Examples of application of the radiochemical and spectrometrical trends of neutron activation analysis for the determination of a number of impurities in pure materials are described. Some theoretical problems of neutron activation analysis are considered. (W.D.M.)

6887 A/CONF.15/P/2032
THE SPONTANEOUS FISSION OF CALIFORNIUM-254 IN TYPE I SUPERNOVAE AND ANOMALY IN THE ABUNDANCE OF THE ISOTOPES OF Te, Xe, AND Sm. I. P. Selinov (U.S.S.R.). 37p.

The laws governing the relative abundance of isotopes and the anomaly in the abundance of the isotopes of tellurium and xenon are considered. An hypothesis is advanced explaining the anomalously great abundance of Te-128, Te-130, Xe-129, and Xe-131 by the addition of decay products of nuclei that arise due to the spontaneous fission of transuranium isotopes. A study is made of the question of the possible symmetric fission of transuranium elements with the formation of nuclei with filled neutron shells and with a total number of neutrons equal to 82. It is suggested that technetium found in type S stars is formed as a result of the neutron synthesis process, which is similar to the synthesis of californium in stars. Experimental data are given on the chemical extraction of tellurium from the Sikhote-Alinsk meteorite, and results are included that point to a difference in the isotopic composition of meteoritic and terrestrial tellurium. A description is given of the principles of the tellurium method of determining the age of rocks from the products of the spontaneous fission of uranium and thorium, an addition of which alters the abundance of the tellurium and xenon isotopes. (auth)

6888 A/CONF.15/P/2034
DISTRIBUTION OF THERMAL-NEUTRON DENSITY ALONG THE RADII OF ROD FUEL ELEMENTS. EXPERIMENT AND COMPARISON WITH THEORY. V. Belkin, P. Krupchitskii (Krupchitsky), Yu. Sidorov, O. Shvedov (U.S.S.R.) APPENDIX. DISTRIBUTION OF NEUTRON DENSITY IN GRAY CYLINDERS (NON-DIFFUSION CALCULATION). L. Voronina, A. Kronrod, Z. Ryabova, and N. Sukhacheva (U.S.S.R.). 21p.

Results of measurements of thermal neutron density along the radii of rod fuel elements for a gas-cooled heavy water reactor are presented. The distributions obtained were used to calculate the screening factors and neutron density drops in the walls of pipes and in air gaps between them. Results are compared with diffusion and kinetic equation results. The kinetic equation was solved for the neutron distribution in gray round cylinders. (W.D.M.)

6889 A/CONF.15/P/2088
GAMMA-IZLUCHENIE VNUTRI I VNE PROTYAZHENNYKH ISTOCHNIKOV. (Gamma-Radiation Inside and Outside Extended Sources). N. G. Gusev, E. E. Kovalev (Kovalyov), and V. I. Popov (U.S.S.R.) 36p.

The shortcomings in the existing methods of calculating the dependence of the dose rate or the intensity of gamma rays on the specific activity of extended

sources are reviewed. A new derivation of the dependence is given, which takes into account self-absorption and multiple scattering of gamma rays in the source, and differs from those previously proposed by its simplicity and better agreement with experiment. Solutions to the problem of self-absorption of gamma rays in a cylinder in a general case, i.e., at any distance from the source, are presented. Results obtained while experimenting on large cylindrical sources with Co^{60} salt solutions differed from those determined theoretically by 15 to 20%. (auth)

6890 A/CONF.15/P/2097
SOME NEW ASPECTS OF PRODUCING HIGH SPECIFIC ACTIVITIES OF RADIOISOTOPES WITH THE AID OF HOT ATOM CHEMISTRY PROCESSES ACCOMPANYING THE NUCLEAR (n,γ) REACTION. Kristian Svoboda (Czechoslovakia). 20p.

Experiments were carried out in an effort to increase the specific activity of radioisotopes produced by the (n,γ) reaction. Quantitative studies were made on the effect of exchange reactions on the yield of the products resulting from the Szilard-Chalmers reaction, and a formula was derived for characterizing the results of the reaction. Expressions are incorporated into the equation which characterize the influence of exchange reactions and allow comparison of results obtained with neutron sources having various intensities of accompanying gamma radiation. (C.H.)

6891 A/CONF.15/P/2106
RAPID ASSESSMENT OF SURFACE RADIOACTIVE CONTAMINATION. F. Běhounek (Karlova Univ., Prague). 8p.

The determination of extended surface radioactive contamination by the usual β-ray counting is lengthy, unprecise, and unsensitive. It can be effected very quickly and with high degree of sensitivity when using the method of discharge of a conductor by the ions produced by the β rays of contaminating radioisotopes. The rate of discharge is directly proportional to the first power of the ion density in the vicinity of the conductor and to the square root of the surface specific activity. The experimental arrangement is very simple. The conductor, a piece of aluminum wire, is screwed on the charging plug of a routine pocket stylo-electrometer. The wire is placed in a distance of 10 cm from the active surface and parallel to it. Specific activities as low as 10^{-4} c/cm^2 of β emitters can be assessed within a few minutes with an accuracy of at least 15 per cent. (auth)

6892 A/CONF.15/P/2128
ATMOSPHERIC RADIOCARBON AS A TRACER IN GEOPHYSICAL CIRCULATION PROBLEMS. T. A. Rafter and G. J. Fergusson (Dept. of Scientific and Industrial Research, Lower Hutt, New Zealand). 20p.

Recent measurements of the C^{14} specific activity of the atmosphere of the southern hemisphere show that the C^{14} specific activity has been increasing at an approximately exponential rate since late 1954. The total increase by December 1957 was 9.30 ± 0.30%. The C^{14} specific activity of the contemporary portion of the biosphere was shown to be increasing at the same rate. The only feasible explanation for this increase in C^{14} specific activity is the production of C^{14} from the testing of atomic weapons. An increase of 2.0 ± 0.5% in the C^{14} specific activity of the surface water of the ocean was observed by December 1957. An exchange time of 3 years for transfer of carbon dioxide from the atmosphere to the surface water of the ocean is indicated by the above measurements. The C^{14} specific activity of fourteen samples of surface ocean water was determined. The results show a fairly uniform activity for regions where no upwelling of deep water occurs. The C^{14} ages for two ocean profiles were determined as well as two samples from Antarctic deep water. The results indicate a much greater C^{14} age for South Pacific and Antarctic water than that reported for Atlantic water. (auth)

6893 A/CONF.15/P/2130
DETERMINATION AND ANALYSIS OF AIR CONTAMINATION BY AIRBORNE ALPHA-EMITTERS OF LOW CONCENTRATION. A. A. Chubakov, V. I. Polikarpov, and V. A. Kuleshova (U.S.S.R.). 21p.

Design and performance data are presented for equipment for continuous monitoring of the atmosphere for alpha activity. Alpha radiations are separated according to their energies, and a continuous record is maintained of long-lived activity. (C.H.)

6894 A/CONF.15/P/2152
MEASUREMENT OF NEUTRON SPECTRUM IN URANIUM WATER LATTICES. V. I. Mostovoy, V. S. Dikarev, et al. (U.S.S.R.). 22p.

The results of neutron spectrum measurements in uranium–water lattices are given. Measurements are made on subcritical assemblies which consist of natural uranium slugs by the method of microbeams; the beams were produced from different points of the elementary cell and then analyzed by a chopper. A water-moderated reactor was used as a primary source of neutrons for the subcritical assembly. Results are compared with some computations, and possibilities of applying the microbeam method for measuring the resonance capture depending on the neutron energy and for obtaining other lattice characteristics are considered. (auth)

6895 A/CONF.15/P/2181
THE TYPE OF GAMOW-TELLER-INTERACTION IN THE DECAY OF Li^8. K. H. Lauterjung and B. Schimmer (Max-Planck-Inst., Heidelberg, Ger.); and H. Maier-Leibnitz (Technischen Hochschule, Munich). 6p.

The electron-antineutrino angular correlation has been determined for the decay of Li^8. Since this decay occurs mainly through the Gamow-Teller interaction, the correlation should be sensitive to the ratio of the two Gamow-Teller coupling constants g_A and g_T. The experimental results show that the axial coupling is predominant. (auth)

6896 A/CONF.15/P/2199
USE OF MICROAUTORADIOGRAPHY AND RADIOMETRY FOR INVESTIGATIONS IN THE THEORY OF FLOTATION. I. N. Plaksin (U.S.S.R.). 24p.

Methods of radiographic investigation were employed depending on the nature and size of the mineral particles. Methods employed included the following: contrast method, for 200 to 500 micron size particles with well defined cleavage; wet method, for particles not exceeding 74 microns; and trace method for studying the reagent distribution over the perimeters of individual particles and reagent adsorption by the individual particles of a flotation pulp. A microautoradiographic procedure was developed for quantative estimation of reagent distribution over the surface of mineral particles. By this procedure the three methods mentioned above can be applied to a study of the distribution of flotation reagent

containing labeled atoms over the surface of the particles of flotation products. (auth)

6897 A/CONF.15/P/2225
PLAZMENNYI VITOK V POPERECHNOM MAGNITNOM POLE. (Investigating the Equilibrium Plasmic Turn in a Transverse Magnetic Field.) S. M. Osovets, Yu. F. Nasedkin, et al. (U.S.S.R.). 42p.

The conditions of equilibrium and stability for an ideally conducting turn in an alternating magnetic field are deduced from the impulse balance equation and from Maxwell's equations. These conditions determine the required configuration of the magnetic field. The behavior of a turn of finite conduction is analyzed in such a field. The lifetime of the turn in an equilibrium state proved to depend in this case on the conduction and the shape of the field. Then the turn contracts toward the center and becomes a cluster consisting of high energy plasma at high density. (auth)

6898 A/CONF.15/P/2243
PROGRAM OF THE INTERNATIONAL COMMISSION ON RADIOLOGICAL UNITS AND MEASUREMENTS. L. S. Taylor and H. O. Wyckoff (National Bureau of Standards, Washington, D. C.); and L. H. Gray (Mt. Vernon Hospital, Northwood, Middx., Eng.). 8p.

Since 1925 the International Commission on Radiological Units and Measurements (ICRU) has been engaged in a continuous study of the units and techniques for the measurement of x rays and nuclear radiations and the intercomparison of the standards. With the introduction of the rad as the unit of absorbed dose it has been necessary to develop the supporting data necessary to apply to ionization and other measurements to convert the readings to ergs/gram. Best values of the following parameters have been developed: primary spectra, distribution functions for initial Compton recoil electron energy, slowing-down electron distribution functions, neutron energy spectra, LET spectra, and relative stopping powers. The application of some of these to particular problems are discussed. A new transfer standard for the intercomparison of x- and gamma-ray standards has been developed, and through the coöperation of the World Health Organization and UNESCO it is made available to countries requiring it. This instrument has a very small energy dependence over a wide energy range. The ICRU has encouraged and fostered the intercomparison of x-ray standards between several countries. A similar program has been developed for the intercomparison of certain standards of radioactivity and a report of the present status of radio-nuclide standards will be presented. Intercomparison of the standards of radium have also been carried out, and an analysis of the results to date is presented. The ICRU, originally established by the International Congresses of Radiology, works closely with WHO in matters of units, standards, and measurement. (auth)

6899 A/CONF.15/P/2326
THE DESIGN AND USE OF PLASTIC BALLOONS FOR STRATOSPHERIC RESEARCH IN INDIA. V. K. Balasubramanian, G. S. Gokhale, M. G. K. Menon, B. Peters, and R. T. Redkar (Tata Inst. of Fundamental Research, Bombay). 9p.

Plastic balloon flying has been developed as a technique of stratospheric research. Applications include cosmic ray studies, air sampling in the stratosphere for fall-out measurements, and meteorological investigations in the stratosphere. Comparatively little work has been done till now in these fields at equatorial latitudes. Large plastic balloons with volumes of the order of half a million cubic feet, and more, have been constructed by heat welding polyethylene sheeting 0.0015-in. thick. These balloons have been successfully launched and flown at stratospheric altitudes. The most serious problem encountered is the extremely low temperature, about −85°C, of the tropopause at the equatorial latitudes. All known plastics for balloon manufacture become brittle at these low temperatures. To overcome this, dark fabrics have been employed so that the material is heated by solar radiation. The plastic sheeting employed is extruded to balloon specifications from chosen polymers. The low temperature and the turbulent conditions that prevail in the equatorial atmosphere present problems in balloon flying, which are very different from those encountered at high latitudes. The techniques employed, the design of the balloons, and their performance under these conditions are discussed. Experiments which it is proposed to carry out with these balloons are outlined. (C.H.)

6900 A/CONF.15/P/2341
CHARACTERISTIC ENERGY ABSORPTION CONSTANT AND ITS USES IN RADIUM AND ISOTOPE DOSIMETRY. K. C. Tsien (National Tsing Hua Univ., Taiwan, China). 23p.

A characteristic energy absorption constant is proposed to replace the gamma-ray dose rate constant now in radium and radioisotope dosimetry. With the use of this constant, a general equation for absorbed dose calculation is formulated without any reference to the roentgen. The geometrical factor in isotope dosimetry is modified so that it is equally applicable to radium cases. Advantages of the method are discussed. (C.H.)

6901 A/CONF.15/P/2452
MEASUREMENT OF THE ABSORPTION OF BETA RAYS IN SOLID AND GAS. F. Barendregt, S. M. Karim, and Askari Imam (Univ. of Karachi, Pakistan). 16p.

The absorption coefficients for beta particles in such solids as paper, tin, metal foils, and copper were determined by exposure to an I^{131} source. In addition, the values of the relative beta-ray transmission coefficients in hydrogen, acetylene, argon, carbon dioxide, and air were determined. The experimental techniques are described, and the results are presented graphically. The experiments are discussed, and it is pointed out that no definite conclusions were drawn. (J.R.D.)

Elementary Particles

6902 A/CONF.15/P/105
SPECTRAL ANALYSIS OF NEUTRONS (250 KEV to 5 MEV) BY MEANS OF NUCLEAR EMULSIONS. C. Beets (Centre D'Étude de l'Énergie Nucléaire, Brussels). 6p.

Supportless detectors of reduced dimensions are described which perturb the flux very little and permit precise positioning. An estimate is given of the resolution attained near 580 kev by using such a detector, Ilford emulsion *L4*, and a photographic counting technique. The improvement in the analysis is discussed and the possibility of observing short tracks by their lengths projected on orthogonal planes is noted. (W.D.M.)

6903 A/CONF.15/P/256
PHYSICS OF K^--PARTICLES. Y. Eisenberg, F. G. Houtermans, et al. (Univ. of Bern). 8p.

Results are presented from a study of 1600 K^- mesons in nuclear emulsions. The tracks of the particles were picked up at a mean kinetic energy which corresponds to 130 Mev and followed until the K^- mesons underwent decay, interactions in flight, or were captured at rest. The general behavior, properties, and strong interactions of K^- mesons are discussed. (W.D.M.)

6904 A/CONF.15/P/268
CONTRIBUTIONS TO KNOWLEDGE OF ELEMENTARY PARTICLES BY STUDIES OF COSMIC RADIATION. C. F. Powell (Bristol Univ., Eng.). 14p.

A brief summary of past contributions of cosmic radiation studies to the physics of elementary particles is given. Some of the advantages of working with cosmic radiation and nuclear emulsions are discussed. The identification of secondary particles in high-energy nucleon interactions is considered. (W.D.M.)

6905 A/CONF.15/P/966
ON THE NEUTRON SLOWING DOWN IN FINITE MEDIA. Walter Humbach (Siemens-Schuckertwerks AG., Erlangen, Ger.). 17p.

In the case of spherically symmetrical scattering, the collision equation for the finite hydrogenous medium is solved by development of the collision density into orthogonal eigenfunctions. The energy-dependent coefficients of the orthogonal functions are described by power laws. In the case of energy-dependent reaction cross section an approximate method is derived. The angular dependence of the scattering for hydrogen and for heavy nuclei is taken into account explicitly. Transport corrections for the Fermi age are derived. For the limiting case of heavy nuclei and weak absorption the results are becoming identical with those of the Fermi theory. A numerical comparison with the method of Goertzel-Greuling is carried out. (auth)

6906 A/CONF.15/P/1086
HYPERON REACTIONS. Fernando E. Prieto (Univ. de México and Inst. Nacional de la Investigación Cientifica, México D.F.). 5p.

By the use of a compound hypothesis for elementary particles, a possible interpretation of hyperon reactions as rearrangement collisions is presented. A composite model for elementary particles is proposed in which the neutron is not a fundamental but a compound particle, and the fundamental particles are supposed to be p, $\bar{p}$, K^0, $\bar{K}^0$, K^+, and K^-. In this model, there are two types of π^0 mesons, with the same properties but with different composition; the binding of any or both of these two types of π^0 mesons to another fundamental or compound particle results in an excited state of this particle. It is shown that the introduction of these π^0 excited states of the elementary particles succeeds in a qualitative description of a great number of observed hyperon reactions. (auth)

6907 A/CONF.15/P/1194
ETUDE DE LA PROPAGATION DES NEUTRONS RAPIDES DANS L'EAU PAR DES METHODES DE MONTE-CARLO. (Monte-Carlo Calculations of Water-Scattered Fast Neutrons.) Pierre LaFore, Robert Lattes, and Jean-Paul Millot (Commissariat a l'Energie Atomique, Paris). 44p.

The exact trajectories of a number of neutrons (4,800) with initial energies ranging from 19.66 Mev to 300 kev were determined during the thermalization of neutrons in water. To determine the neutron life, the position, direction, and energy of neutrons are calculated for each collision by the use of random numbers associated with the pertinent probability laws. To improve the results, full consideration was given to the first collision. The slowing down of the neutrons was determined, and the reflection of fast neutrons by the water and the neutron albedo was calculated. (J.S.R.)

6908 A/CONF.15/P/1283
ON ANGULAR CORRELATION IN $\pi^+ - \mu^+ - e^+$ DECAYS. H. Hulubei, J. Ausländer, E. Balea, E. Friedländer, and S. Tzitzeica (Inst. de Physique Atomique, Bucharest). 20p.

In nuclear plates exposed at the synchrocyclotron of the Joint Institute for Nuclear Research in Dubna (U.S.S.R.) 8880 complete $\pi^+ \rightarrow \mu^+ \rightarrow e^+$ events were measured with respect to the projected angles ($\pi\mu$) and (μe). The assymetry factor of the distribution $1 + a\cos\theta$ of the $\mu - e$ decay is estimated. The influence of scanning bias on the apparent angular distribution of $\pi - \mu$ decays is discussed. (auth)

6909 A/CONF.15/P/1206
SPECTROMETRIE ET DOSIMETRIE DES NEUTRONS RAPIDES. (Fast Neutron Spectrometry and Dosimetry.) S. Blaize, J. Ailloud, J. Mariani, and J. P. Millot (Commissariat a l'Energie Atomique, Paris). 20p.

The spectrometry and dosimetry of fast neutrons were studied by using the recoil protons produced in hydrogenated material. The spectra of fast neutrons from a heavy water reactor, a graphite reactor, and the $T(d,n)He^4$ reaction were determined by the classical method of proton tracks in nuclear emulsions. A non-directional neutron dosimeter was built from polyethylene covered with zinc sulfide. The dose was determined by simple counting, and the response of the detector was tested for different energies. (J.S.R.)

6910 A/CONF.15/P/1297
UNE MÉTODE POUR LA MESURE ABSOLUE DES FLUX DE NEUTRONS THERMIQUES. (An Absolute Measurement of Thermal Neutron Fluxes with the Help of Nuclear Emulsions). Horia Hulubei, C. Beşliu, Al. Berinde, M. Ivaşcu, and N. Martalogu (Univ. of Bucharest). 6p.

A method is given for the absolute measurement of thermal neutron fluxes with the aid of nuclear emulsions. A nuclear plate soaked in lithium borate is cut into a number of sections which are irradiated with the thermal neutron flux to be measured. The irradiation time varies from one section to the next. The concentration of the tracks $\Delta N = N\sigma\phi\epsilon$, corresponding to each section of the emulsion, is placed on a straight line of slope $s = N\sigma\phi$ which permits the evaluation of ϕ. The experimental details of a complete measurement are described, and some of the results are given. (J.S.R.)

6911 A/CONF.15/P/1317
SUR UNE POSSIBILITÉ DE DÉTERMINER Z A L'AIDE DES RAYONS DELTA. (A Method for the Identification of the Z Charge of an Ionizing Particle by Means of Delta Rays). Calin Beşliu and Marius Petrasco (Univ. of Bucharest). 9p.

The relationship $m/m_0 = n/n_0$, where m_0 is the mass of a standard particle, n is the number of grains between two densities d_1 and d_2 on the unknown track, and n_0 is the number of grains between the same densities in the standard track, is used to identify an unknown particle with mass m in a nuclear emulsion. This re-

lation is extended to determine the charge Z of the ionizing particle by considering the density of the delta rays. The margins of error and the limits of applicability of the method are discussed. (J.S.R.)

6912 A/CONF.15/P/1332
ISOTOPIC SPIN AND STRANGE PARTICLES. Gyo Takeda (Tokyo Univ.). 10p.

This report was previously abstracted in NSA 12-6741 as INS-PT-2.

6913 A/CONF.15/P/1335
MU-MESON INTERACTION WITH MATTER. PART I. COMMENTS ON THE "ANALOGOUS" SCATTERING OF MU-MESONS. Shuji Fukui (Osaka Univ.) and Takashi Kitamura and Yuzuru Watase (Osaka City Univ.). PART II. MESON PRODUCTION. S. Higashi, H. Mitani, T. Shino, H. Shibata, K. Watanabe, and Y[uzuru] Watase (Osaka City Univ.). 32p.

A study of μ-meson scattering was made by making use of an apparatus capable of selecting only μ mesons, their momenta being determined with a thick absorber and a delayed coincidence method within a narrow range of 1 ± 0.2 Bev/c. The observed angular distribution of scattered μ mesons was found to be in good agreement with that of the coulomb scattering theory for extended nuclei obtained by Copper and Rainwater. An experiment is described which establishes the existence of a difference between features of nuclear interactions of μ mesons and those of π mesons. The difference is discussed in reference to multiple meson production. (W.D.M.)

6914 A/CONF.15/P/1371
INTERACTIONS OF K MESONS. N. Dallaporta (Istituto di Fisica dell'Università, Padua and Istituto Nazionale di Fisica Nucleare, Padua). 29p.

Recent ideas on the classification of the elementary particles in theoretical schemes are generally based on well defined assumptions concerning the type and the strength of the interactions between different particles. From this point of view the determination of the characteristics of the strong interactions of K mesons are of the utmost importance. A collection and summary of the actual experimental data concerning the strong interactions of both K^+ and K^- mesons are presented. Some of the theoretical approaches that have been made to interpret these data are given in order to see whether, from the actual situation, some conclusions concerning these interactions can be drawn. (auth)

6915 A/CONF.15/P/1372
NEUTRON TEMPERATURE MEASUREMENTS WITH PULSED NEUTRON SOURCES. E. Santandrea, F. Toselli, and G. Viano (FIAT. Sezione Energia Nucleare, Turin). 15p.

The 31 Mev Betatron of Turin University was used for setting up a pulsed neutron source. This technique was applied to measuring the time decay constant of the neutron density in aqueous media. Different bucklings and poisonings of cadmium sulfate and boric acid at different concentrations were used. Therefore, an indication of the dependency of the neutron temperature on the capture and leakage characteristics of the media may be derived. (auth)

6916 A/CONF.15/P/1375
DIRECT MECHANISM IN N,P REACTIONS AT 14 MEV. L. Colli, I. Iori, G. Marcazzan, and Anna Sona (Centro Informazioni Studi Esperienze, Milan) and U. Facchini (Univ. of Turin). 10p.

A series of measurements on n,p reactions with neutrons having 14.5 Mev energies are discussed. Seventeen nuclei were studied having a Z number between Mg^{12} and Au^{79}. For each nucleus an examination is made of the spectrum of emitted protons, the cross sections, and, in some cases, their angular distribution. The examination of these data and other measurements shows how in the case of heavy nuclei a mechanism of direct collision between the incident neutron and the proton of the hit nucleus is evident. A comparison between the reactions (n,p) and (n,2n) leads to the conclusion that the emission of neutrons is instead due to a process of the evaporative kind. It may be noted that the emission of protons is affected by the presence of Coulomb barrier and that the experimental cross-section is of greater magnitude than can be calculated according to the theory of direct collision developed by Hayakawa and others. The possibility is considered of obtaining cross-sections nearer to experimental ones, considering that the direct collision takes place at the surface. In the case of medium and light nuclei it proves more difficult to separate the direct effect from possible evaporating processes. The angular distribution indicates that the forward proton emission is favored by 20 to 30%. The cross-section for reactions n,p, n,n', and n,2n are of the same magnitude. Because of lower Coulomb barriers the energy spectra of protons extend over an energy range where both the direct effect and evaporation are expected to be present. (auth)

6917 A/CONF.15/P/1565
STUDY OF A PAIR OF $\pi^+ + \pi^-$ MESONS WITH UNUSUAL CHARACTERISTICS. Beatriz Roederer and Juan Roederer (Comision Nacional de Energía Atómica, Buenos Aires). 4p.

During calibration of a block of Ilford G-5 emulsions exposed at 29 km over Italy, a pair of ionization tracks were found close to the level of minimal ionization. After careful measurements these were determined to be π^+ and π^- mesons originating in the center of the block and directed upward. A number of hypotheses on the production process are examined. It is concluded that a neutral particle of $\sim 600\ m_e$ and $Q = 2 \pm 5$ Mev is disintegrated into two bodies. (W.D.M.)

6918 A/CONF.15/P/1604
ON THE PROBLEM OF MOTION OF ELEMENTARY PARTICLES. Géza Szamosi (Israel Atomic Energy Commission). 15p.

The space-time picture of the relativistic motion of a mass point is examined. The relativistic time concept is analyzed. It is shown that by using this general time concept, a canonical method can be constructed in the framework of the theory of relativity, with the help of which one can pass on to quantum theory in the same way as in classical mechanics. The basic concept of the fully-covariant one-particle quantum mechanics is dealt with. The possibility of extending the limits of the one-particle quantum mechanics is discussed. (W.D.M.)

6919 A/CONF.15/P/1621
DETERMINATION OF MASS DISTRIBUTION USING ALPHA-PARTICLES. H. Bretler and H. N. Steiger (Israel Inst. of Tech., Haifa). 21p.

The possibility of using alpha particles to determine mass distribution in very thin layers of materials is investigated. The objects are placed between the source and an emulsion, and the blackening of the exposed emulsion is proportional to the thickness. The experi-

mental setup is described. Optimal conditions were found after careful investigation of all the factors such as source preparation and protection, source strength and size, object thickness, geometric conditions, etc. It is believed that mass differences of 10^{-15} g can be detected by improvements in the experimental set-up. (W.D.M.)

6920 A/CONF.15/P/1631
EXPERIMENTS CONCERNING THE EXISTENCE OF PARTICLES OF MASS ~ 550 m_e. N. Durga Prasad and O. P. Sharma (Tata Inst. of Fundamental Research, Bombay). 8p.

While studying the mass spectrum of slow cosmic-ray particles at an altitude of 3250 m, Alikhanian et al. obtained, in 1956, evidence suggesting the existence of particles of mass ~ 550 m_e. These particles appeared to be predominantly negative, had a long lifetime, and came from the cosmic-ray beam; none appeared to originate in nuclear interactions. A search for these particles was made in a stack of 18 Ilford G5 emulsions exposed for five months at an altitude of 11,000 ft, $\lambda = 24°N$ at Khillinmerg (Kashmir). 4000 tracks were examined in this search. No evidence for the existence of particles of mass ~ 550 m_e was obtained. The probability of observing these particles in our sample in 88% if their relative abundance is ½%, compared to μ-mesons in the same range interval. The question of the existence of these particles, in the light of the above evidence, and observations obtained by other groups in experiments to detect them are discussed. (auth)

6921 A/CONF.15/P/1640
EXPERIMENTS ON FAST NEUTRON DISTRIBUTIONS IN WATER AND NEUTRON AGE IN WATER–ALUMINUM MIXTURES. V. P. Duggal, S. M. Puri, and K. Sri Ram (Atomic Energy Establishment, Trombay, India). 18p.

Spatial distribution of fast neutrons (E > 1 Mev) and resonance neutrons (1.45 ev) was measured in water from a point source of monoenergetic neutrons of 14.1-Mev energy and a fission source of neutrons. The experimental distributions were compared with theoretical calculations. Neutron slowing-down age at indium resonance (1.45 ev) was determined in different water–aluminum mixtures employing Ra-α-Be, D-T (14.1 Mev), and D-D (2.8 Mev) neutrons. Theoretical calculations for the determination of age were also made taking into account the anisotropy in elastic scattering and absorption effects. The comparison with experimental values shows a better agreement than has been reported hitherto. (auth)

6922 A/CONF.15/P/1699
SECTIONS EFFICACES TOTALES POUR DES NEUTRONS D'ÉNERGIE VOISINE DE 2,5 ET 14 Mev. (Total Cross Sections for Neutrons with Energies Close to 2.5 and 14 Mev Respectively.) J. Vervier, G. Deconninck, and A. Martegani (Univ. of Louvain, Belgium). 15p.

The total cross section of F and Mg were measured in the region of 3 Mev. For Mg a resonance was found at 2.5 Mev. Measurements made of Pb, Bi, and Cu in the same region agree with previous results after corrections are made. The total cross section for Ag and Mo were determined for 14-Mev neutrons. The results are graphed. (J.S.R.)

6923 A/CONF.15/P/1965
ORIGIN OF COSMIC RAYS. Satio Hayakawa, Kensai Ito, and Yoshinosuke Terashima (Kyoto Univ.). 13p.

The origin of cosmic rays is discussed by paying attention to the role of possible local sources. From the charge spectrum of primary cosmic rays the charge spectrum at local origins as well as the mean free path for cosmic-ray particles traversing the interstellar matter were deduced. The charge spectrum at sources was discussed in reference to the formation of elements in various stages of the stellar evolution. Various modes of energy transformations in the Crab nebula, as one of the most important local sources, were examined on the basis of the synchrotron radiation and the Californium hypothesis. A detailed analysis of the electromagnetic radiation from the Crab nebula helped to obtain the energy and spatial distributions of relativistic electrons. The balance sheet with regard to the outcome and income of energy was discussed. This indicates a very high efficiency of acceleration, possibly due to the motion of magnetic fields. On that basis, the cause of the high efficiency is that the energy transfer to relativistic particles could be faster than to other modes in such a tenuous plasma. A comparison was made with the acceleration of cosmic rays at the solar flare. A betatron-like process was proposed as a possible mechanism of acceleration. In addition to these rather well-known sources, the role of other probable sources was briefly considered with a view to preparing a thorough review on the origin of cosmic rays. (auth)

6924 A/CONF.15/P/1966
ON THE UNUSUAL INCREASE OF COSMIC-RAY INTENSITY OF FEBRUARY 23, 1956. Masatoshi Kitamura (Meteorological Research Inst., Tokyo). 12p.

The data of cosmic-ray intensity observed over the world were used to study the unusual increase of cosmic-ray intensity which was connected with a solar flare on February 23, 1956, and to investigate the propagation process of solar cosmic-ray particles through interplanetary space. The decline of particle intensity as a function of time, except for high-energy particles, is favorable to the diffusion mechanism of solar cosmic-ray particles through the interplanetary space from the source to the earth, and the latitude dependence of the time at which maximum intensity of solar cosmic-ray in American zone took place confirms the diffusion mechanism of the particles. Also, a clear distinction is found between the time of onset of cosmic-ray increase in German-Soviet zone and American zone. That is, the particle intensity increased more promptly in the German-Soviet zone than in American zone in high latitudes. It is shown that the particles arriving at the former region promptly were transmitted straight from the source which is in the inner solar system of magnetic field-free cavity and affected by the geomagnetic field in the vicinity of the earth, while the particles arriving at the latter region were propagated through interplanetary space by a diffusion mechanism. Radius of the particle source is inferred to be 0.8 to 0.9 A. U., judging from the width of prompt onset region on the earth in conjunction with the calculation of the impact zone by R. Liist. Observed facts and theoretical considerations lead to a model in which the inner solar system is a magnetic field-free cavity of radius 0.8 to 0.9 A. U. enclosed by magnetic gas clouds, through which the solar cosmic-ray particles are diffused and reach the interstellar space. It is concluded considering the diffusion process of the particles through interplanetary space, that the integral energy spectrum of solar cosmic-ray particles is proportional to E-5 instead of E-7 proposed by J. A. Simpson and others. (auth)

6925 A/CONF.15/P/1967
AN EXPERIMENTAL STUDY OF EXTENSIVE AIR SHOWERS AND THE RELATION TO PRIMARY COSMIC RADIATION. S. Miyake, K. Hinotani, I. Katsumata, and T. Kaneko (Osaka City Univ.). 9p.

An investigation of extensive air showers was performed at Mt. Norikura (2840 m above sea level. The air shower structure near the shower axis was studied in relation to the shower size. In this experiment, it is made clear how the core structure of the air shower depends upon the size of shower. Two interpretations are introduced; one is that the character of high-energy nuclear interaction varies with the energies, and the other is that primary energy spectrum of cosmic radiation decreases more sharply as the energy increases than can be expected from many experimental results so far obtained. From an analysis of the absorption length, it is plausible to consider that the primary energy spectrum has an upper limit of 10^{17} to 10^{18} ev. Some features for the origin of the cosmic radiation and for the shower curves of extensive air showers may be deduced. The change in the character of the nuclear interaction with the increase of energy is not unreasonable. The shower curve of the air shower has not been investigated in detail, but it seems that the curve shows a maximum at about 400 to 500 g/cm^2, and a ratio between the size at 1000 g/cm^2 and at maximum is about several tens. Energy spectrum of the primary cosmic radiation decreases more sharply than that so far obtained, and the effective upper limit is about 10^{17} ev. If this speculation is correct, the origin of the cosmic radiation is located in the inner space of the galaxy. (auth)

6926 A/CONF.15/P/1968
THE EMULSION CHAMBER PROJECT IN JAPAN. O. Minakawa, Y. Nishimura, M. Tauzuki, and H. Yamanouchi (Kobe Univ., Japan); H. Aizu and H. Hasegawa (Rikkyo Univ., Japan); Y. Ishii and S. Tokunaga (Kyoto Univ.); Y. Fujimoto, S. Hasegawa, J. Nishimura, and K. Niu (Tokyo Univ.); K. Nishikawa (Wakayama Univ., Japan); and K. Imaeda and M. Kazuno (Yamanashi Univ., Japan). 4p.

The background for the emulsion chamber project is reviewed, and the chamber is described. Experiments to measure the transverse momenta in high-energy jets are described. Future plans of the nuclear emulsion group are discussed. (W.D.M.)

6927 A/CONF.15/P/1969
AN AIR SHOWER PROJECT. T. Matano, I. Miura, M. Oda, K. Suga, G. Tanahashi, and Y. Tanaka (Tokyo Univ.). 5p.

The structure and features of a project in Tokyo to study extensive air showers are described. The features which were emphasized for the design of the project include: facility for determination of the size of the shower, the location of the axis, and the angle of incidence for individual showers; and the deviation of each shower from the average, in addition to the study of the averaged nature. The detail of the structure of the shower core has a close connection with the nature of the elementary interaction process. The structure of the electronic component and the N component is studied with emphasis on energy measurement. The existence of an extremely high-energy N particle is important. A description of measurement apparatus and technique is included. (auth)

6928 A/CONF.15/P/1976
MEAN FREE PATH OF NUCLEAR INTERACTION FOR HIGH ENERGY PARTICLES IN C. J. R. Manzano, O. R. Santochi, J. C. Anderson, J. M. Cardoso, H. Ghielmetti, and A. A. Cicchini (Comisión Nacional de Energia Atomica, Buenos Aires). 12p.

An analysis of the penetrating local showers in a hodoscope with a Geiger-Mueller counter made it possible to distinguish between the interactions of different energies. According to the data, a reduction of the mean free path is observed with an increase in the energy. Conversely, the results obtained with the customary method of a nonsubdivided absorbent show no differences. This work was carried out at Mina Aguilar, province of Jujuy, 4000m above sea level, at a geomagnetic latitude of 11° south. (auth)

6929 A/CONF.15/P/2038
STUDIES IN THE PHYSICS OF FAST NEUTRON REACTORS. A. I. Leipunskii (Leipunsky), A. I. Abramov, V. N. Andreev, et al. (Atomic Energy Utilization Central Board, U.S.S.R.). 46p.

Results of research carried out on fast reactor physics at the Institute of Physics of the Atomic Energy Utilization Central Board are presented. Description is given of studies on fission neutron propagation through thick spheres of U^{238}. The experiments helped to determine a number of U^{238} properties defining the role of U^{238} fission in fast neutron reactors. Experimental results achieved on a series of critical assemblies are given for reactor power not in excess of 30 w. The reactor core consisted of plutonium rods. The critical facility design made it possible to study the reactor cores with relatively high plutonium content. The reactor control was accomplished by moving the inner parts of screens. Three reactor design versions are described in detail. In one of them the screen is made of solid uranium slugs. In the second reactor design version it consists of a close uranium water lattice separated from the core by a layer of solid uranium. In the third design version a nonfissionable screen made of copper is used. Neutron detectors of different sensitivity to neutron energy allow determination of the neutron energy spectrum in different parts of the reactor. Direct measurements of the neutron spectrum were made. The reactivity perturbations caused by foreign particles in the reactor vessel were measured, and measurements of space dependence of the neutron value for different neutron energies were made. Experimental results are compared with the data calculated by the multigroup kinetic theory. Basic results of nuclear research of the 100-kw experimental fast neutron reactor with mercury cooling are described. Space distribution of different processes, neutron energy spectrum, efficiency of regulating instruments, temperature effects, and other parameters of the reactor have been measured. Comparison is made of the experimental results with the results of theoretical calculations. (auth)

6930 A/CONF.15/P/2039
ANGULAR CORRELATION OF CHARGED PARTICLES FROM URANIUM FISSION INDUCED BY HIGH ENERGY PROTONS AND π^+-MESONS. N. S. Ivanova (Iwanowa), V. I. Ostroumov (W. I. Ostroumow), and R. A. Filov (Filow) (U.S.S.R.). 20p.

The results obtained in experiments on uranium fission induced by 660-Mev protons and by 280-Mev π^+ mesons, which were carried out with the aid of nuclear

emulsions, are reported. The angular correlation of the two protons which arise as a result of the interaction of a fast meson with a uranium nucleus was investigated. Analysis of data obtained leads to the conclusion that π^+-meson capture occurs mainly as a result of interaction with a pair of nucleons. The measurements of the angular distributions of charged particles accompanying the uranium fission induced by high-energy protons were carried out. The data obtained show that such protons were emitted before the fission process. In the case of α particles some increase of probability of their emergence at large angles with respect to the direction of movement of fission fragments was observed. The various factors which can be responsible for such an effect are considered. (auth)

6931 A/CONF.15/P/2102
KINETICHESKAYA TEORIYA DIFFUZII NEITRONOV V PLOSKOI RESHETKE: NEKOTORYE TEORETICHESKIE REZUL'TATY. (Neutron Transport Theory in Slab Lattices: Some Theoretical Results.) L. Trlifaj and J. Čermák (Czechoslovakia). 23p.

Certain theoretical results concerning neutron diffusion in slab lattices, attained on the basis of the transport theory, are discussed. Monoenergetic neutron diffusion, diffusion of neutrons with variable energy under the assumption of a regenerating spectrum in a lattice formed by heavy nuclei, and finally, neutron slowing down in a lattice formed by fuel and moderator are analyzed. The starting point is the integral form of the Boltzmann equation, which is solved by various methods: by a method based on a variational principle, by a method called a "group coördinate method," and by the spherical harmonics method. Some of the results obtained are inverse diffusion length, material buckling, and the period of an infinite slab lattice. Diffusion length and material buckling dependence on the source or boundary position, the behavior of these constants at a limiting case of infinitely thin slabs, and an expression for neutron escape probability are also discussed. (auth)

6932 A/CONF.15/P/2148
NEUTRON THERMALIZATION AND DIFFUSION IN HEAVY MEDIA. M. V. Kazarnovskii (Kazarnovsky), A. V. Stepanov, and F. L. Shapiro (U.S.S.R.). 32p.

Problems of neutron thermalization and diffusion theory for heavy media are discussed. An age equation type expression for space-energy distribution of slow and thermal neutrons in a heavy nonuniform monatomic gas moderator with a weak absorption is derived and an expression for space-energy distribution near the boundary of two media is obtained. The slow neutron spectrum in a heavy crystalline medium is calculated for the energy region where the thermal motion and chemical bonds of the moderator atoms are important. A multigroup method of analyzing neutron diffusion in a heavy medium is developed which takes into account changes in neutron energy distribution. The influence of thermal motion and of the crystalline bonds on time-energy distribution of slow neutrons in heavy moderators is investigated. It is shown that the distribution width increases with the medium effective temperature. (auth)

6933 A/CONF.15/P/2189
PASSAGE OF NEUTRONS IN A HETEROGENEOUS MEDIUM. N. I. Laletin (U.S.S.R.). 25p.

The distribution of monoenergetic neutrons is considered in a two-component heterogeneous medium. One component is a periodic lattice consisting of arbitrary-shaped cylinders. The rest of the space is occupied by another component. It is assumed that there is no absorption throughout. The kinetic equation in the integral form (Peierls' equation) is then investigated for cases when the plane neutron source is arranged in parallel or perpendicular to the axis of the medium's symmetry. Formulas are obtained for effective diffusion coefficients. In the case of rods consisting of plates, formulas are given which help to obtain the effective diffusion coefficients for any plate thickness. In the case of rods in the form of circular cylinders, a formula is obtained for the neutron diffusion coefficient in a direction which is parallel to the axis of the medium symmetry, and another formula for a part of a diffusion coefficient in a perpendicular direction. It is shown that the diffusion coefficient in the limit of thin plates and rods is identical for all directions and is equal to the diffusion coefficient for the homogeneous mixture. Furthermore, a medium with the presence of a small absorption and a multiplying medium of sufficiently great dimensions are considered. Formulas of a general form are obtained for effective diffusion coefficients and neutron diffusion lengths. (auth)

6934 A/CONF.15/P/2224
PRIMENENIE TEORII ONZAGERA K ISSLEDOVANIYU DIFFUZII NEITRONOV V POGLOSHCHAYUSHCHIKH SREDAKH YADERNYKH REAKTOROV. (Application of Onzager's Theory in Investigations of Neutron Diffusion in Absorption Media of Nuclear Reactors.) A. I. Veinik, V. S. Ermakov, and A. V. Lykov (U.S.S.R.). 10p.

Neutron transfer in absorptive media is considered on the basis of Onzager's thermodynamic theory, according to which the motive power of neutron diffusion transfer is a gradient of neutron concentrations and a temperature gradient. Instead of the universally adopted differential equation of neutron diffusion a differential equation system is offered for neutron and heat transfer with sources of matter (neutron) and heat discharge. The relation between matter sources and heat is defined by the neutron absorption criterion. Single value conditions are set down with a consideration of concrete conditions of the interchange between heat and matter on the surface of the heat-producing body. A range of new criteria is obtained from the transfer differential equation system and single valued conditions, such as: the criterion of inertial changes in the neutron concentration field in relation to changes in the field of temperatures and the criterion of neutron concentrations redistribution under the effect of the temperature gradient. These criteria characterize the neutron and the heat exchange processes in absorption media. The relation between the non-defining and defining criteria of the neutron-heat exchange allows the basis of a method of modelling heat and mass exchange in the absorptive media of nuclear reactors to be outlined. (auth)

6935 A/CONF.15/P/2454
MEASUREMENT OF OMNIDIRECTIONAL INTENSITY OF COSMIC RAYS AT KARACHI. S. M. Karim, M. O. Ghaznavi, et al. (Univ. of Karachi, Pakistan). 11p.

Measurements of the omnidirectional intensity of cosmic rays were made in terms of counts per second per unit length. Geiger-Mueller counters, with associated electronic equipment, were used. It was found that except for small yearly variations the values were the same for three years. The results of the daily measurements are tabulated. (J.R.D.)

Heat Transfer and Fluid Flow

6936 A/CONF.15/P/87
THERMAL RESISTANCE BETWEEN URANIUM AND CAN. R. G. S. Skipper and K. J. Wootton (General Electric Co. Ltd., Erith, Kent, Eng.). 17p.

The fuel element cans of most of the current gas-cooled graphite-moderated reactors are not bonded to the uranium fuel. Good contact between can and fuel is ensured by a pressurizing operation during the canning process. The temperature drop at the interface will be small compared to the can-to-gas temperature drop, but an accurate knowledge of it is vital to the fuel element design. The cause of the temperature drop between metal surfaces in contact is discussed, and theoretical methods that have been put forward for evaluating it are considered, including the prediction of the effect of can-filling gas between the surfaces. The effect of mean free path to gap ratio is noted as being important when the filling gas pressure is low. The beneficial results of pre-pressurizing are considered. The experimental approach to the problem is discussed. Experiments which have been carried out using flat plates of uranium and magnesium alloy in contact are described, with special reference to the apparatus designed by The General Electric Company for this purpose. The effects of interface temperature, interface pressure, the choice and pressure of the filling gas, and surface oxidation are considered from the experimental results, and the agreement with theoretical predictions is discussed. (auth)

6937 A/CONF.15/P/253
HEAT TRANSFER IN A ROUND DUCT WITH SINUSOIDAL HEAT FLUX DISTRIBUTION. L. S. Dzung (Brown, Boveri & Co., Baden, Switzerland). 37p.

The problem is treated for the case of established velocity profile in the steady pipe flow. Mass density and molecular transport properties of the fluid are assumed to be constant. The heat flux distribution along the duct wall is taken as half a complete sine wave. The extension to truncated half-wave is indicated. The case of uniform heat flux, of which a direct treatment is difficult, turns out to be a limiting case of truncation. (W.L.H.)

6938 A/CONF.15/P/254
HEAT TRANSFER IN A FLAT DUCT WITH SINUSOIDAL HEAT FLUX DISTRIBUTION. L. S. Dzung (Brown, Boveri & Co., Baden, Switzerland). 15p.

Flat ducts find application in the cooling of nuclear reactors and may be considered as approximating annular gaps. It is assumed that the velocity profile is fully developed. The technique used in solving the round duct case is extended to cover this case, thereby making it necessary to explain the mathematics only briefly. The points in which the treats differ are discussed. (W.D.M.)

6939 A/CONF.15/P/1055
SPECIAL NONUNIFORM FUEL-DISTRIBUTIONS AND COOLING-PROBLEMS IN REACTORS. F. Winterberg (Gesellschaft fur Kernenergieverwertung, Hamburg). 29p.

Several special nonuniform fuel distributions are discussed. The importance of these distributions is a consequence of the demand for a favorable cooling of the reactor core. Special distinguished nonuniform fuel distributions are given which lead to a constant power density in the core, constant surface-temperature of the fuel elements, and constant highest fuel temperature. In order to fulfill these requirements, the enrichment of the fuel can be varied parallel and perpendicular to the direction of the cooling channels. Moreover, they will be fulfilled under constant enrichment perpendicular to the direction of the cooling channels by variation of the volume ratio of moderator to fuel, the cooling flow rate, and the hydraulic diameter of the cooling channels. Combinations of these modes are possible. The calculations are based on a multi-group diffusion model. The fuel distributions have been computed for a series of simple core geometries with finite and infinite reflectors. A complete analytical solution is only possible with an infinite reflector. If there is only a finite reflector or even no reflector, the solution can be expanded in series. (auth)

6940 A/CONF.15/P/1149
CONTRIBUTION A L'ETUDE DE LA CONVECTION FORCEE DE LA CHALEUR DANS LES ESPACES ANNULAIRES EN VUE DE L'APPLICATION AU REFROIDISSEMENT DES CANAUX DE REACTEURS. (Experimental Investigation on Convective Heat Transfer in Annuli for Application to the Cooling of Reactors.) Ch. Bory and H. Cordier (Univ. of Poitiers, France). 38p.

Convective heat transfer was investigated with two apparatuses of the same geometry, but in one case the wall temperature of the heated inner cylinder was constant and in the other case the heat flux was uniform. The local coefficient of heat transfer in a partially developed flow was determined. Air at atmospheric pressure and temperature was used as the fluid, and the velocity varied from 0 to 120 m/sec. The method used for the measurement of the local coefficient of heat transfer is described. The effect of the geometry of the annuli, the effect of the air entry, and the distribution of the imposed flux were studied. (J.S.R.)

6941 A/CONF.15/P/1170
CONTRIBUTION A L'ETUDE DES TRANSFERTS DE CHALEUR INTENSES DANS LES TUBES. (Contribution to the Study of Strong Heat Transfer within Tubes.) Olivier and Lachmitt (Société Nationale d'Etude et de Construction de Moteurs d'Aviation, Paris). 5p.

As the Colburn formula for the Margoulis number gave inaccurate results at high temperatures, an investigation was made to find an expression for the Margoulis number better adapted to high temperatures. The Prandtl-Karman friction law, which was valid only in the absence of heat transfer, was modified, and an analogy relation between the friction and the heat transfer was developed which accounted for the temperature difference between the walls of the tube and the fluid. The expression derived was applied to some experimental results on an electrically heated cylindrical tube 10 mm in diameter and 1 m long. The maximum temperature of the tube varied from 900 to 1100°C, and the temperature difference between fluid and wall was about 400°C. The investigation was made over a range of Reynolds numbers from 35,000 to 200,000. A comparison of the measured and computed values of the temperature excess of the wall over fluid temperature shows a discrepancy of about 4%. (J.S.R.)

6942 A/CONF.15/P/1288
ON HEAT TRANSFER BETWEEN A LIQUID-FLUIDIZED BED AND THE CONTAINER WALL. E. Ruckenstein (Polytechnical Inst., Bucharest) and

V. Shorr and G. C. Suciu (Oil and Gas Inst., Bucharest). 13p.

An experimental study concerning the heat transfer between a bed fluidized with oil or water and a wall is presented. The experimental results were correlated by means of nondimensional groups. Empirical equations were established to represent these results. The interpretation of the experimental results, as well as of some results obtained by other authors concerning the fluidization by air, was made by a model which improves the one proposed by Levenspiel and Walton. The equation obtained starting from this model is in better agreement with experiment than the one proposed by Levenspiel and Walton. (auth)

6943 A/CONF.15/P/1367
GAS-LIQUID AND VAPOR-LIQUID MIXTURES AS COOLING AGENTS. M. Silvestri, S. Finzi, L. Roseo, M. Schiavon, and R. Zavattarelli (Centro Informazioni Studi Esperienze, Milan). 22p.

Physical properties of gas-liquid and vapor-liquid mixtures are suitable, in many cases, for forced convection heat transfer, all the more so because of the very high apparent heat capacity when the liquid component has a high latent heat of vaporization. Pressure drops were determined for different gas-liquid mixtures, in different experimental conditions, keeping the gas in turbulent flow and the liquid both in viscous and in turbulent flow. The following parameters were varied: tube diameter, total pressure, liquid and gas flow rates, and liquid viscosity. Experimental data can be correlated by quite simple relationships. Heat transfer properties were studied on steam-water and gas-water mixtures. In electrically heated tubings heat transfer coefficients for steam-water mixtures were determined at various pressures, at different specific flow-rates and for different liquid-to-steam flow-rate ratios, up to burn out conditions. Maximum values of the heat transfer coefficients are of the same order of magnitude as those obtained in pressurized water systems, whereas the density of the mixtures, also in the very high pressure range, are much lower than liquid densities. These properties seem to give to gas-liquid or vapor-liquid mixtures some interest as cooling agents for nuclear reactors. (auth)

6944 A/CONF.15/P/2210
HEAT TRANSFER IN LIQUID METAL PIPE FLOWING. S. S. Kutateladze, V. J. Subbotin, et al. (U.S.S.R.). 26p.

Periodic flow fluctuations may occur in steam-producing tubes: free fluctuations evoked by elasticity in the system and forced fluctuations occurring under periodic perturbating force effects. Both types of fluctuations represent a variety of discontinuous movement, the flow discontinuity being determined not by external causes but by the forces acting inside the system. These fluctuations can occur both in natural and in forced circulations. Free circulations take place when the steam-producing tubes in the beam stand vertically. Forced fluctuations, commonly called pulsations, are of great significance for straight-flow boilers with long steam-producing turns. The conditions under which both types of fluctuation appear are considered, and the conditions that are required for their cessation are given. The dependence for the flow fluctuation period is given. (auth)

6945 A/CONF.15/P/2470
ISSLEDOVANIE NESTATSIONARNOGO PERENOSA TEPLA V TEPLOVYDELYAYUSHCHIKH ELEMENTAKH YADERNYKH REAKTOROV. (Investigation of Nonstationary Heat Transfer in Heat Emanating Elements in Nuclear Reactors.) V. S. Ermakov and A. V. Ivanov (U.S.S.R.). 22p.

The temperature distributions in heat-emanating elements were investigated for use in studies of neutron attenuation processes in reactor fuel elements. (R.V.J.)

6946 A/CONF.15/P/2475
SKOROSTNOI METOD IZMERENIYA KOEFFITSIENTA TEPLOOTDACHI V TRUBE. (A Fast Method for Measuring the Heat Exchange in a Pipe.) M. N. Ivanovskii, V. I. Subbotin, and P. A. Ushakov (U.S.S.R.). 21p.

A fast method for measuring the heat exchange in a pipe was developed, based on the temperature changes in the liquid with considerations for the specific properties of the analyzed liquid metals. (R.V.J.)

Nuclear Properties and Reactions

6947 A/CONF.15/P/4
DIRECT RADIATIVE CAPTURE IN NUCLEAR REACTIONS. A. M. Lane and J. E. Lynn (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 31p.

The expression used by Beck to represent direct capture is derived from nuclear dispersion theory, thereby, giving it a more substantial foundation than is provided by phenomenological arguments. Estimates are made of the cross sections expected for capture by the compound nucleus process at incident energies above 5 Mev, and these are compared with those for the direct process. A similar comparison of the two mechanisms is made for capture occurring at energies between resonances in low-energy neutron bombardment. A discussion of the data in light of these estimates is given. (W.D.M.)

6948 A/CONF.15/P/6
FISSION PROCESSES IN THE PROTON BOMBARDMENT OF Th^{232}, U^{238}, AND Pu^{239}. J. P. Butler and F. Brown (Atomic Energy of Canada, Ltd., Chalk River, Ont.), and B. J. Bowles (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 16p.

The ratio of symmetric to asymmetric fission was determined in the proton bombardment of Th^{232}, U^{238}, and Pu^{239} using the nuclides Ag^{113} and Ba^{139}, respectively, to typify these two modes of fission. The ratio was measured as a function of the proton energy over the range 6 to 100 Mev, with determinations at 1.0 Mev intervals in the range 6 to 50 Mev. The ratio does not rise steadily with increasing proton energy, but it exhibits a periodic decrease superimposed upon the over-all increase. These decreases or dips are quite pronounced in the results obtained with Th^{232}, but almost undetectable in Pu^{239}, with U^{238} being intermediate. The occurrence and periodicity of the dips are attributed to the various competing fission reactions, (p,f), (p,nf), $(p, 2nf)$, etc., in which the excess neutrons associated with high-energy fission (6 to 50 Mev) are evaporated from the compound nucleus before the fission event occurs. (auth)

6949 A/CONF.15/P/11
SOME NEUTRON CROSS SECTIONS OF IMPORTANCE TO REACTORS Tc^{99}, Nd^{143}, Nd^{145}, Sm^{149}, Sm^{152}, Eu^{151}, Eu^{153}, Gd^{155}, Gd^{157}, AND Pu^{240}. N. J. Pattenden (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 24p.

Crystal spectrometer measurements on Tc^{99}, Nd^{143},

Nd^{145}, Sm^{149}, Eu^{151}, Eu^{153}, Gd^{155}, Gd^{157}, and Pu^{249} are described in detail. The measurements are combined with published resonance parameters to obtain convenient data from which effective cross sections in neutron spectra at different temperatures up to 2000°K may be estimated. (W.D.M.)

6950 A/CONF.15/P/35
TIME OF FLIGHT MEASUREMENTS OF RESONANCE PARAMETERS USING THE HARWELL PULSED NEUTRON SOURCE. J. R. Bird (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 9p.

A description is given of measurements of the gamma rays emitted following neutron capture in mercury and tungsten using the Harwell Linear Accelerator as a pulsed neutron source. The various types of information which can be obtained from these measurements is compared with the results from other experiments. (W.D.M.)

6951 A/CONF.15/P/52
PRECISION MEASUREMENTS OF $\bar{\nu}$ BY THE BORON PILE. D. W. Colvin and M. G. Sowerby (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 11p.

A neutron detector of high efficiency is described. This consists of 240 BF_3 counters mounted in a cubic graphite pile of side 220 cm. The detector is surrounded by a 35 cm graphite reflector and a 2 ft concrete shield. $\bar{\nu}$ is determined by placing a fission chamber in the center of the pile and counting, using a gating system to reduce the background, the number of neutrons detected per fission occurring in the chamber. Results are given for the thermal neutron induced fission of several nuclides. The method is described by which the efficiency of the detector and hence the values of $\bar{\nu}$ are accurately determined. (auth)

6952 A/CONF.15/P/119
EFFET ISOTOPIQUE DANS LA CAPTURE RADIATIVE DES NEUTRONS ($^{80}_{35}Br$ ET $^{82}_{35}Br$). (Isotopic Effects of Br 80 and Br 82, as Formed by Radiative Capture.) P. C. Capron, P. Colas, J. Debaisieux, and L. Gilly (Inst. Interuniversitaire des Sciences Nucléaires, Brussels and Univ. of Louvain, Belgium). 10p.

The isotopic effects in neutron capture were studied with dibromoethane and isopropyl bromide. These compounds were irradiated by thermal and resonance neutrons. After the irradiation some of the product was placed on chromatograms. Alcohol, pyridine with 10% water, and water were used as eluants. The behavior of the Br^{80} and Br^{82} formed by the (n,γ) reaction was studied by a comparison of the activity of the two isotopes the length of the chromatogram. With both thermal and resonance neutrons the chromatogram had several activity peaks which showed the isolation at that point of one or several specific chemical compounds. For the same chromatogram the activity ratios were never constant which meant that the reaction products were formed preferentially either with Br^{80} or Br^{82}. The chemical behavior of the two isotopes was not the same in the case of irradiation with thermal neutrons or with resonance neutrons. The reaction products are influenced by the neutron energy. (J.S.R.)

6953 A/CONF.15/P/139
A FISSION COUNTING METHOD FOR URANIUM ISOTOPE ANALYSIS. Gösta Nilsson (AB Atomenergi, Stockholm). 26p.

A fission counting method for uranium isotope analysis was developed. The method involves a measurement of the ratio between the fission counting rate of an unknown sample and a standard sample and a spectrophotometric determination of the ratio between their uranium contents. From these two measurements the abundance ratio % U^{235} in unknown sample/% U^{235} in standard sample is calculated. To determine the fission counting ratio a fission chamber was constructed and its properties investigated. The chamber is fitted to one end of an aluminum tube, the other end is connected to an iron block for radiation shielding and the whole equipment (2 m long) is inserted into one of the channels of the Swedish Reactor R1. (auth)

6954 A/CONF.15/P/149
GAMMA SPECTRA OF GROSS FISSION PRODUCTS FROM THERMAL REACTORS. Jan Prawitz, Kerstin Löw, and Rolf Björnerstedt (Research Inst. of National Defence, Stockholm). 20p.

Calculations of gamma spectra from products of thermal fission of U^{235} are presented. The fission yield values and decay data used are taken from literature published up to April 1958. The calculations cover seven different irradiation times from one day to two years and continuous cooling times from one day to 1000 years. The gamma activities were grouped in 0.2-Mev intervals. The composition of the fission product mixture is somewhat dependent on the absolute neutron flux in the reactor. This matter is discussed. The results are presented as a diagram for each irradiation time, showing the decay of the different energy groups with cooling time. (auth)

6955 A/CONF.15/P/150
MEASUREMENTS AND CALCULATIONS OF THE TEMPERATURE COEFFICIENT OF THE EFFECTIVE RESONANCE INTEGRAL IN URANIUM METAL AND OXIDE. PART I. P. Blomberg, E. Hellstrand, and S. Hörner (AB Atomenergi, Stockholm). PART 2. S. Brimberg and J. Dahlström (ASEA, Västerås, Sweden). 41p.

The temperature coefficient of the effective resonance integral for U^{238} was determined in the range 20 to 600°C for the metal and 20 to 1000°C for UO_2. The samples, placed in a cadmium covered oven, were irradiated at different temperatures in the reflector of the Swedish heavy water reactor, R1. A quantity proportional to the resonance absorption in U^{238} was obtained by measuring the intensity of the 103-kev x-ray line in Pu^{239} following Np^{239} decay. As an S/M-dependence of the temperature coefficient cannot be ruled out from theoretical reasons, the measurements were made with metal rods and oxide pellets with three different diameters ranging from 8 to 28 mm. (auth)

6956 A/CONF.15/P/150(Rev. 1)
CALCULATIONS OF THE TEMPERATURE COEFFICIENT OF THE EFFECTIVE RESONANCE INTEGRAL IN URANIUM METAL AND OXIDE. PART 2. S. Brimberg and J. Dahlström (ASEA, Västerås, Sweden). 27p.

Numerical calculations of the resonance integral are given for cylindrical rods of U and UO_2 both as single rods and as clusters of rods. The rod diameter, the lattice pitch, and the temperatures of the fuel and D_2O moderator were varied. The temperature coefficients α, β, and total were calculated. (W.D.M.)

6957 A/CONF.15/P/187(Rev. 1)
ABSOLUTE YIELDS OF THE ISOTOPES OF XENON AND KRYPTON IN THE NEUTRON FISSION OF Pu-239.

K. Fritze, C. C. McMullen, and H. G. Thode (McMaster Univ., Hamilton, Ont., Can.). 11p. (AECL-597). $0.25(AECL).

Using isotope dilution techniques and mass spectrometry, absolute yields of the Xe and Kr isotopes in the neutron-induced fission of Pu^{239} were determined. Nine of these yields lead to cumulative yields of the respective mass chains 131, 132, 134, 136, 83, 84, 85, 86, and two give absolute independent yields of the shielded precursors in their respective mass chains, namely I^{128} and I^{130}. (W.D.M.)

6958 A/CONF.15/P/197

DISTRIBUTION OF NUCLEAR CHARGE IN THE PROTON-INDUCED FISSION OF Th-232. B. D. Pate, J. S. Foster, and L. Yaffe (McGill Univ., Montreal). 18p. (AECL-607). $0.25(AECL).

Independent formation cross sections for I^{130}, I^{131}, Te^{131}, I^{132}, and I^{134} and cumulative formation cross sections for Te^{132}, I^{133}, and I^{135} in the proton-induced fission reactions of Th^{232} have been measured radiochemically using $4\pi\,\beta$ counting. Bombardments with protons in the energy range 8 to 87 Mev were performed with the McGill synchrocyclotron. These data have been combined with published information on mass distributions to give charge distribution curves in the mass region 130 to 135 at various bombarding energies. These curves display, with increasing energy, a shift of most probable charge towards stability, and a concomitant widening of the distribution showing the increasing competition between fission and neutron evaporation The experimental results are compared with those from calculations based on models of nuclear cascade and evaporation processes. (auth)

6959 A/CONF.15/P/198

SEMIEMPIRICAL CORRELATION OF FISSION-YIELD AND KINETIC-ENERGY DISTRIBUTIONS. A. G. W. Cameron (Atomic Energy of Canada Ltd., Chalk River, Ont.). 16p. (AECL-608). $0.25(AECL).

A statistical approach to a theory of fission was introduced by Fong. In the final development of the fission theory, however, Fong made extensive use of the liquid-drop model, thus departing from the purely statistical approach. T. D. Newton revived and improved the statistical approach sufficiently to show that it might reproduce some but not all of the properties of the fission process. Improved atomic masses and nuclear-level spacings are used in Newton's formulation of the statistical theory of fission. The integrals of the theory are evaluated with fewer approximations. Agreement is obtained with Newton's conclusion that the statistical approach is by itself inadequate, but it is found that it can form the basis of a semiempirical procedure for correlating fission yields and kinetic-energy distributions. (W.D.M.)

6960 A/CONF.15/P/199

FISSION FRAGMENT VELOCITY DISTRIBUTION AND COINCIDENT GAMMA SPECTRA FOR Cf^{252}. J. S. Fraser and J. C. D. Milton (Atomic Energy of Canada Ltd., Chalk River, Ont.). 20p. (AECL-609.) $0.25(AECL).

The velocities of both fragments from the spontaneous fission of Cf^{252} were measured by the time-of-flight method. The pulse-height spectrum produced by the prompt gamma rays in a large NaI(Tl) crystal was recorded simultaneously with the velocity data. The average total kinetic energy of the fragments before neutron emission was found to be 181.9 ± 5 Mev. The full width at half maximum of the kinetic-energy distributions decreases from 22 Mev near symmetric fission to 17 Mev at the most probable mass ratio of 1.33 then increases to 20 Mev for the more asymmetric modes. The widths of the kinetic-energy distributions were corrected for neutron recoil and the average total kinetic energy for the effect of the angular dispersion of the fragments by the prompt neutrons. The corrected width of the kinetic-energy distribution at the most probable mass ratio (17 Mev) is in agreement with the corresponding fluctuation in fragment excitation energy that is required to explain the known prompt-neutron-number distribution. The yield of gamma rays shows a pronounced dip in the region where the mass of one of the fragments is close to that of the doubly-magic nucleus $_{50}Sn^{132}$. There is some evidence that the average gamma-ray energy is higher in this region. A similar but less pronounced trend is indicated in the region where the light fragment is near the 50-neutron shell. The influence of the $_{50}Sn^{132}$ core is also seen in the kinetic-energy distribution. (auth)

6961 A/CONF.15/P/200

PHOTOFISSION IN HEAVY ELEMENTS. L. Katz (Univ. of Saskatchewan, Saskatoon) and A. P. Baerg and F. Brown (Atomic Energy of Canada Ltd., Chalk River, Ont.). Includes Appendix: CALCULATION OF ANGULAR RESOLUTION CORRECTIONS. P. M. Dyson, J. M. Kennedy, and E. Vogt (Atomic Energy of Canada Ltd., Chalk River, Ont.). 31p.

Measurements of photofission cross sections for a number of heavy-element nuclides were made by counting, in an ionization chamber, the fission fragments from foils irradiated in the bremsstrahlung beam of the University of Saskatchewan betatron. Parameters describing the giant-resonance fission cross section curves were obtained for Th^{232}, U^{233}, U^{238}, Np^{237}, Pu^{239}, and Am^{241} The yields of fissions are compared with the yields of neutrons measured previously in the same laboratory and the relative probabilities of the reactions (γ,f) and (γ,n) are obtained as a function of energy In a second series of experiments the angular distribution of the fission fragments relative to the photon beam was measured as a function of energy. The nuclides U^{233}, U^{235}, Np^{237}, Pu^{239}, and Am^{241} give an isotropic distribution. The nuclides Th^{232} and U^{238} give an anisotropic distribution of the form $1 + \alpha \sin^2\theta$, the degree of anisotropy being very large at low energies and falling rapidly with increasing energy. A mixture of 30% Th^{230} and 70% Th^{232} gave an angular distribution indistinguishable from that of pure Th^{232}. (auth)

6962 A/CONF.15/P/201

MASS-SPECTROMETRIC STUDIES OF PILE POISONS AND THEIR YIELDS IN THE FISSION OF U-233, U-235, AND Pu-239. D. R. Bidinosti, H. R. Fickel, and R. H. Tomlinson (McMaster Univ., Hamilton, Ont.). 13p. (AECL-611). $0.25(AECL).

A mass-spectrometric comparison of fission yields obtained at various neutron fluxes and irradiation times has made possible the measurement of pile-neutron absorption resulting from the accumulation of several fission products in a D_2O-moderated reactor. The following pile-neutron absorption cross sections have been measured relative to Co^{59} = 36.0 barns: Cs^{133} = 40 barns, Pm^{147} = 207 barns, Sm^{149} = 85,000 barns, Sm^{151} = 11,500 barns. Some of these values are considerably higher than thermal-neutron values be-

cause of resonance absorption. Cumulative yields of each of these nuclides as well as those of the 135 and 143 mass chains have also been measured by isotope-dilution techniques for the thermal-neutron fission of U^{233} and Pu^{239}. These measurements, together with the previously published cross section of Xe^{135} and fission yields for U^{235}, make possible a comparison of these poisons in reactors using U^{233}, U^{235}, and Pu^{239} fuels. In twenty-three mass chains where the stable or long-lived end products have low absorption cross sections, it has been possible to eliminate the possibility of significant neutron absorption amongst the short-lived precursors. (auth)

6963 A/CONF.15/P/203
RADIOCHEMICAL METHODS APPLIED TO THE DETERMINATION OF CROSS SECTIONS OF REACTOR INTEREST. T. A. Eastwood, A. P. Baerg, et al. (Atomic Energy of Canada Ltd., Chalk River, Ont.). 23p. (AECL-613). $0.25(AECL).

Measurements of neutron capture cross sections of fission products, U^{236}, and Pa^{232}, and fission cross sections of the less fissionable isotopes of neptunium and plutonium are reported. The activation method of measuring neutron capture cross sections was used for most of the work described because it is suitable for experiments with radioactive species where the amounts available are small. Radiochemical purity is essential for the successful application of the method and chemical procedures, some of them fairly rapid, were developed to meet this requirement. Accuracy was improved by the use of such techniques as β- and γ-ray spectrometry and 4π proportional β counting. The high flux and rapid sample-handling facilities of the NRX reactor have made possible techniques which might not otherwise be used. (auth)

6964 A/CONF.15/P/204
THE SLOW NEUTRON FISSION CROSS SECTIONS OF THE COMMON FISSILE NUCLIDES. C. B. Bigham, G. C. Hanna, et al. (Atomic Energy of Canada Ltd., Chalk River, Ont.). 24p. (AECL-614). $0.25(AECL).

The fission cross sections of U^{233}, U^{235}, Pu^{239}, and Pu^{241} were measured, relative to gold, in a Maxwellian neutron spectrum. The techniques employed are entirely conventional, but by careful attention to detail the overall error was reduced to less than one per cent. The masses of fissile material used were determined by alpha counting which was done in the same chamber as the fission counting without disturbing the samples. Two types of measurements were made. In the first, precise ratios of the fission cross sections were obtained. The ratios of the cross sections of Pu^{239} and Pu^{241} and of U^{233}, and U^{235} were obtained independent of alpha half lives by using an isotopic dilution technique. In the other measurement, the fission cross section of U^{233} was determined relative to the activation cross section of gold. The absolute activity of the gold foils was measured in a 4π γ scintillation counter by comparison with Au^{198} samples standardized in a 4π β-γ coincidence system. (auth)

6965 A/CONF.15/P/342
ETUDE DE TRANSITIONS ELECTROMAGNETIQUES DANS LES NOYAUX LEGERS PAR LA METHODE DES CORRELATIONS ANGULAIRES DES PAIRES DE CONVERSION INTERNE. (Study of Electromagnetic Transitions in Light Nuclei by Means of the Method of Angular Correlations of Pairs of Internal Conversion.) S. Gorodetzky, P. Chevallier, et al. (Inst. de Recherches Nucleaires, Strasbourg). 4p.

Electromagnetic transitions between nuclear levels compete with the relatively rare process of internal conversion pairs. It is possible to demonstrate that the angular correlation of such a pair is very sensitive to the multipole order of the corresponding electromagnetic transition. Experimental measurement of the correlation demonstrated the multipolarity of γ transitions. The energy of each of the electrons of the pairs is measured separately (this energy is spread out over a continuous spectrum); then the results are summed and the sum corresponds to the energy of the γ transition. A certain number of transitions were characterized, allowing, in addition, the assignment of spin and parity to the levels concerned in the transition. The phenomenon of monopolar pairs is similar. It appears, for example, in the transitions $0^+ \rightarrow 0^+$ (oxygen). Electromagnetic transition is naturally prohibited. The transition occurs by pairs. The angular correlation of these pairs was computed from Dirac theory. A more rigorous calculation, using modern quantum electrodynamics, gives a slightly different result, especially at angles 0 and 180°. This effect, which is difficult to obtain experimentally, would be of great interest if it could be realized. Attempts along this line are in progress. (auth)

6966 A/CONF.15/P/551
MASS DISTRIBUTION IN FISSION. L. W. Roeland (Univ. of Amsterdam), and L. M. Bollinger and G. E. Thomas (Argonne National Lab., Lemont, Ill.). 12p.

The mass distribution was measured for resonances in U^{233} and U^{235}. In U^{236}, the mass distributions associated with both the epithermal region and the 8.9 ev resonance of the fission cross section spectrum show an increase in the amount of symmetrical fission as compared with the thermal neutron distribution of about 35%. The epithermal region of U^{233} shows also an increase in this quantity, although it is much smaller, barely 10%. Finally, the mass distribution for the resonance at 1.8 ev of U^{233} is the same within the experimental accuracy as the one for the thermal region. (auth)

6967 A/CONF.15/P/583
THE DELAYED NEUTRON PRECURSORS IN FISSION. Alexic C. Pappas (Univ. of Oslo). 26p.

A survey of the experimental data on delayed neutron half lives and yields gives indication for the existence of a greater number of delayed neutron precursors than the six commonly accepted. This finds further support in the fact that the ratio of delayed neutron yield to cumulative fission yield of a delayed neutron precursor depends on the fissioning nuclide when computed from observed data. By means of a semitheoretical approach based on systematics of β-decay energies, highly improved mass formulas, and theory for delayed neutron emission, the probability for delayed neutron emission is estimated. From this approach the distribution of delayed neutron precursors in a N, Z diagram is obtained. By coupling with known fission mass and charge-distribution curves the maximum possible number of delayed neutron precursors in thermal and low-energy fission is estimated to be in the vicinity of 50. Of the possible delayed neutron precursors about two thirds are odd Z nuclides and one third even Z nuclides. Of the elements concerned the largest amount of delayed neutron precursors is expected to be isotopes of bromine and iodine. (auth)

6968 A/CONF.15/P/984
MICRO-DETERMINATION OF ISOTOPE ABUNDANCE

BY NEUTRON ACTIVATION. E. Merz and W. Herr (Max-Planck-Inst. fur Chem., Mainz). 11p.

The principle and efficiency of the neutron activation method for determining isotopic abundance is demonstrated on the elements Hf, Os, W, Ru, and Br. The results of the radiometric analyses were compared with mass spectrometric controls and showed good agreement. (W.D.M.)

6969 A/CONF.15/P/1088
SECCIONES TOTALES EMPLEANDO NEUTRONES RAPIDOS. (Cross-Sections for Fast Neutrons of Some Elements.) M. Mazari and F. Alba (Univ. Nacional Autónoma de Mexico). 6p.

The total cross sections for fast neutrons were determined for sodium, iron, strontium, zirconium, and thallium. The experimental results were compared with the theoretical results. (J.S.R.)

6970 A/CONF.15/P/1090
INVESTIGATION OF THE STRONG AND WEAK INTERACTIONS OF POSITIVE HEAVY MESONS. G. Alexander, F. Anderson, et al. (Dublin Inst. for Advanced Studies and University Coll., Dublin). 17p.

Experiments were conducted on nuclear interactions in flight and the weak interactions involved in decay of positive K mesons using the photographic emulsion technique. The nuclear interactions in flight of the K^+ particles were studied by "track scanning" and recording events where a heavy meson appeared to have interacted with a nucleus in the emulsion. Cross-section measurements were made in the regions 0 to 130 Mev and 250 to 300 Mev. The main features of the nuclear interactions in the lower-energy region are summarized. The decays of K^+ mesons at rest have been studied. (W.L.H.)

6971 A/CONF.15/P/1186
MEASUREMENT OF THE FISSION CROSS SECTIONS AND NUMBERS OF PROMPT NEUTRONS EMITTED BY FISSION. P. Billaud, C. Clair, M. Gaudin, R. Genin, R. Joly, J. L. Leroy, A. Michaudon, J. Ouvry, C. Signarbieux, and G. Vendryes (Commissariat à l'Énergie Atomique, Paris). 45p.

A fission cross section of 0.10 barns was measured for U^{238} using 13.6-Mev neutrons from the reaction $T(d,n)He^4$. The number of prompt neutrons emitted in fission by 14.2-Mev neutrons of U^{238} and Th^{232} was measured. The effective neutron fission cross section for slow neutrons of Pu^{239} was measured. The fission cross section of U^{235} for intermediate energy neutrons was measured by time-of-flight methods. (W.D.M.)

6972 A/CONF.15/P/1188
COMPARATIVE PROBABILITIES FOR FISSION WITH THE EMISSION OF LONG-RANGE PARTICLES FOR VARIOUS MATERIALS IRRADIATED BY SLOW AND FAST NEUTRONS. F. Netter, Henriette Faraggi, Arlette Garin-Bonnet, Jean Julien, Charles Corge, and Jean Turkiewicz (Commissariat à l'Énergie Atomique, Paris). 7p.

Measurements of the effective cross section for ternary fission of U^{233}, U^{235}, U^{238}, and Pu^{239} as a function of neutron energy are described. (W.D.M.)

6973 A/CONF.15/P/1333
ODD PARITY DEFORMATION OF ATOMIC NUCLEI. Syota Suekane and Wataro Watari (Osaka City Univ.). 14p.

The surface rigidity is calculated for the surface deformation of order 3 including spin-orbit coupling in accordance with the theory of Marumori, Suekane, and Yamamoto. The shell structure dependence on surface rigidity and the relationship with the deformation of order 2 are investigated. The effect on asymmetric nuclear fission is discussed. The adiabatic approximation to the particle motion is used. (W.D.M.)

6974 A/CONF.15/P/1373
RECENT RESULTS ON NEUTRON PHOTOPRODUCTION. R. Malvano (Univ. of Turin). 14p.

The experimental results recently obtained in the betatron laboratory of the University of Turin are collected and discussed. In the field of light nuclei the photoneutron process in Al^{27}, which shows a peculiar behavior of the fast neutron component, is discussed. In the field of medium elements, the very interesting case of Mo^{100} is presented. In the field of heavy elements four cases are selected: Ta, Tl, Pb, and Bi. The measurement of the total photoneutron cross sections were extended as far as 31 Mev and the results are compared with the measurements carried on the separate fast neutron component. In the case of Ta, the photoneutron energy spectrum was studied, with the aid of nuclear plates, obtaining a clear indication about the "very direct" photoneutron effect. Besides, in the case of Tl, Pb, and Bi a complete set of measurements were carried on to study the isomeric states following photoneutron emission. Some conclusions, about the multiple process $(\gamma,2n)$ and a discussion on the possible mechanism of photon absorption at energies above the giant resonance are included. (auth)

6975 A/CONF.15/P/1482
ENERGY LEVELS IN CHROMIUM ISOTOPES. F. A. El Bedewi and S. Tadros (Alexandria Univ., Egypt). 22p.

A magnetic spectrograph with photographic detection was used to study the proton groups emitted from deuteron interactions with a thin chromium target. Applying deuterons of energy 8.67 Mev, nine well defined proton groups attributed to the isotope 52 of chromium yield Q values of 5.73, 5.16, 4.72, 3.41, 3.04, 2.11, 1.60, 1.50, and 1.09 Mev with errors of ±0.02 Mev. Four weak groups of protons having Q values of 6.68, 6.26, 4.89, and 4.46 Mev with errors of ±0.04 Mev may belong to the $Cr^{53}(d,p)Cr^{54}$ reaction. In view of the present energy levels in Cr^{53} and Cr^{54}, interpretation of some gamma groups emitted from previous work on neutron capture of chromium is given. The angular distributions for the proton groups corresponding to the transition to the ground state and five low-lying levels in Cr^{53} are compared with theoretical curves based on deuteron stripping mechanism. Odd parity is identified to all the examined energy levels, and information about their possible spins, relative capture probabilities, and relative reduced widths is obtained. (auth)

6976 A/CONF.15/P/1479
A PROPOSAL FOR CLASSIFICATION OF NUCLEAR REACTIONS. M. A. El-Guebely and M. El-Nadi (Egyptian Atomic Energy Commission, Cairo). 17p.

An approach to the problem of classification of nuclear reactions, based on the mechanism of the various processes, is discussed. Characteristics of each category are outlined. Similarly, a definition of the various energy ranges is proposed, and its physical justification is dealt with. Reactions are defined in eight groups, and examples of each group are given. (W.D.M.)

6977 A/CONF.15/P/1504
INTERACTIONS OF PIONS WITH THE EMULSION NU-

CLEI. M. Innas Ali and A. Q. Sarker (Univ. of Dacca, Pakistan). 8p.

Extensive calculations of the absorption cross sections and the diffraction cross section were made for the elements C, N, O, S, Br, Ag, and I with a view of getting the opacity of the pion in emulsion. The aim is to predict the absorption cross sections of pions in the Bev energy range in G-5 emulsion. The calculations for Ag are discussed. (W.D.M.)

6978 A/CONF.15/P/1505
ELASTIC SCATTERING OF PROTONS BY He^3 AND OF NEUTRONS BY H^3. M. Innas Ali, A. Hossain, and M. Islam (Univ. of Dacca, Pakistan). 11p.

The differential scattering cross section for the elastic scatterings of protons by He^3 and of neutrons by H^3 were calculated at center of mass energies 7.31, 6.45, 3.72, and 10.72 Mev, respectively. The calculations were done on the basis of nuclear shell model using a square well with a spin-orbit coupling term. The spin orbit coupling term was introduced in such way as to produce a variable potential well depth depending on the angular momentum. Two square well depths 36 and 42 Mev were used. The theoretical curves give marked agreement with the experimental results. Theoretical curves of Swan are also given for comparison. (auth)

6979 A/CONF.15/P/1513
ANGULAR DISTRIBUTIONS IN PARTICLE INDUCED FISSION AT MEDIUM ENERGIES. I. Halpern and V. M. Strutinski (Copenhagen Univ.). 28p.

The problem of angular distributions of fission fragments is treated from the viewpoint first developed by Bohr and Mottelson. A general expression is derived for the angular dependence of the cross-section for fission induced by particles with energies up to a few tens of Mev's. The fragment angular distribution depends on the mean square angular momentum, $\overline{I^2}$, which is introduced by the incident particles into the nucleus and on the distribution of K values in the fissioning nucleus. K denotes, as usual, the projection of the nuclear spin on the nuclear symmetry axis. The K distribution is obtained from statistical considerations. It has a Gaussian form whose width depends in part on the effective moment of inertia of the compound nucleus at that time in the fission process when the final K distribution is frozen in. This width also depends on the nuclear temperature, T, measured at the same time. The theory provides a simple expression for the anisotropy, $\sigma(0^\circ)/\sigma(90^\circ)$. (auth)

6980 A/CONF.15/P/1564
γ SPECTRUM OF Rh^{106} (130 ± 2 min.). S. Mayo and S. J. Nassiff (Comisión Nacional de Energía Atómica, Buenos Aires). 9p.

This paper was previously abstracted as NSA 11-12209 and NSA 12-17735.

6981 A/CONF.15/P/1567
MODERATION OF NEUTRONS BY ELASTIC COLLISIONS IN A HEAVY MONATOMIC GAS, AN INFINITE MEDIUM THAT ALLOWS FOR THERMAL AGITATION. Juan U. Koppel (Comisión Nacional de Energía Atómica, Buenos Aires). 24p.

The range of energies of the moderating process is investigated using a monatomic gas of considerable atomic weight. This is a relatively simple case because it is not necessary to allow for the chemical bonds of the dispersing nuclei, and also because simplifying approximations are applicable. The thermalization process is described independently of the $\Sigma_s(E)$ function. (W.D.M.)

6982 A/CONF.15/P/1570
A NEW OSMIUM ISOTOPE WITH EXCESS NEUTRONS. P. Rey and G. B. Baró (Comisión Nacional de Energía Atómica, Buenos Aires). 12p.

A study was made of Ir and Os isotopes with excess neutrons, which can be obtained by the action of neutrons on platinum. Disintegration curves are given for Ir^{195}, Os^{192}, and Os^{195}. It was determined that Os^{189} and Os^{192} were stable and had no known isomers. Two isomers (14 hr and 16 days) were found for Os^{191}. The 6.5-min half life activity was concluded to be Os^{195}. (W.D.M.)

6983 A/CONF.15/P/1571
Hf^{183}—A NEW ISOTOPE OF HAFNIUM. O. O. Gatti and J. Fiegenheimer (Comisión Nacional de Energía Atómica, Buenos Aires). 9p.

Neutron bombardment of W produces a half life of 64 ± 3 minutes in the hafnium fraction. The maximum β^- energy of this nuclide is about 1.4 Mev, and its total disintegration energy $Q(\beta^-)$ is about 2.2 Mev. This value agrees with the predicted $Q(\beta^-)$ value for Hf^{183}. The mass number is confirmed by the amount of radioactive Ta^{183} formed after decay of the hafnium. The reported 10-minute half life for Ta^{186} is confirmed. (auth)

6984 A/CONF.15/P/1572
SOME NEW CADMIUM AND INDIUM ISOTOPES. N. Nussis, R. H. Rodriguez Pasqués, J. Pahissa Campá, M. C. Palcos de Enquin, and E. Ricci (Comisión Nacional de Energía Atomica, Buenos Aires). 13p.

The half life of Cd^{119} was determined to be 10 min. A new isotope of Cd with a half life of 3.5 ± 0.5 min was found, which is the radioactive parent of two In nuclides having half lives of 11 ± 1 and 32 ± 2 min. The maximum energy of the emitted neutrons from 11.5-min In is 1.2 and 3.8 Mev while that of 32-min In is ~1.7 Mev. An investigation of the gamma radiation from these nuclides identified three rays: 850 kev (11.5 min), 740 kev(3.5 min), and 520 kev (32 min). It is impossible to assign mass numbers to the nuclides although the 3.5-min Cd and its descendants are probably of mass 121. (W.D.M.)

6985 A/CONF.15/P/1573
NEW DATA ON ANTIMONY ISOTOPES CONTAINING EXCESS NEUTRONS. I. Früns, J. Rodriguez, and R. Radicella (Comision Nacional de Energia Atomica, Buenos Aires). 7p.

The nuclear data pertaining to antimony isotopes containing an excess of neutrons are reviewed, and mass number 128 is assigned to the isomers Sb (10.3 min) and Sb (9.6 h) by measuring the excited 760-kev level obtained from uranium fission with deuterons and by the Te(d,α)Sb reaction. A half life of 18.8 minutes, corresponding to Sb^{126}, is determined by making a measurement on the 650-kev line fundamental level for Te^{126}. (auth)

6986 A/CONF.15/P/1574
ON THE NUCLEAR CONSTANTS OF Fe^{61}. J. Pahissa Campa, E. Ricci, and N. N. Nussis (Comisión Nacional de Energía Atomica, Buenos Aires). 6p.

Fe^{61} emits β^- particles and γ rays. The maximum energy of the beta particles emitted was measured by the absorption method, and it was found to be equal to 2.7 Mev. In addition to this, a comparison of the beta

and gamma activities obtained afforded a means of computing the total disintegration energy, which was ascertained to be 3.8 Mev. For Fe^{61}, a gamma ray of 0.29 ± 0.03 Mev was identified, using a cathode-ray oscillograph. Various tests also were carried out in order to compute the half life of Fe^{61}. The results obtained warrant the assigning of a 6.0 ± 0.5 minute half life, as against 5.5 minutes assigned previously. (auth)

6987 A/CONF.15/P/1590
EXCITED LEVELS OF NUCLEI WITH MIXED CONFIGURATIONS. PART I. METHOD OF CALCULATION. Z. Szymański (Inst. of Nuclear Research, Warsaw). 19p.

This paper was previously abstracted in NSA 12-12643 as NP-6801.

6988 A/CONF.15/P/1599
ABSOLUTE THERMAL FISSION CROSS SECTION MEASUREMENTS OF U^{235} BY A NEW METHOD. A. Şaplakoğlu (Univ. of Ankara). 8p.

An examination of the standard methods of determining the fission cross section shows that the principle sources of error are uncertainties in the spectrum of the incident neutrons, the energy dependence of the cross sections of the material being studied, the thickness of the fission foil, and the value of some reference cross section. A new method is described which eliminates all of these sources of error and in principle seems capable of giving results of very high accuracy. The results obtained from a measurement of the U^{235} absolute fission cross section are presented. (W.D.M.)

6989 A/CONF.15/P/1615
A MONTE CARLO CALCULATION OF FISSION-SPALLATION COMPETITION. I. Dostrovsky, Z. Fraenkel, and P. Rabinowitz (Weizmann Inst. of Science, Rehovoth, Israel). 28p.

A systematic study of the competition between fission and evaporation occurring throughout the deexcitation process is described. The general aim is to obtain a clearer understanding of this competition, rather than to interpret specific experimental results. To this end, emphasis is laid upon the study of the effects of various parameters on the fission-spallation competition. The parameters studied included A, Z, and E of the excited nucleus, level density parameter, critical Z^2/A, surface energy, and temperature correction to fission barrier. Work was carried out with the aid of a fast electronic computer. The program developed for computing the fission-spallation competition by the Monte Carlo Method is briefly described. (auth)

6990 A/CONF.15/P/1632
NUMBER OF NEUTRONS EMITTED PER FISSION FROM THE FAST FISSION OF U-238. V. R. Nargundkar, R. B. Prabhu, R. Ramanna, N. Umakantha, and P. K. Khopkar (Atomic Energy Establishment, Trombay, India). 5p.

Neutrons of fission and 14-Mev energy were obtained by placing uranium and lithium deuteride disks, respectively, in front of one of the beam holes of the swimming pool reactor, Apsara. The neutron beam was collimated into a well shielded detector assembly made up of BF_3 counters embedded in paraffin. The secondary target was placed inside the assembly such that the fast neutrons were incident on it. From the increase in the number of neutrons recorded the value of $\sigma_a(\eta-1)$ was measured. η has been estimated from the published values of σ_a. (auth)

6991 A/CONF.15/P/1633
THE ANGULAR DISTRIBUTION OF PROMPT NEUTRONS EMITTED IN THE FISSION OF U-235. R. Ramanna and P. N. Rama Rao (Atomic Energy Establishment, Trombay, India). 9p.

A special type of ionizing chamber which measures the angle between a fission fragment and the electric field of the ionization chamber has been constructed. This was used in conjunction with a fast neutron scintillation detector placed along the direction corresponding to the electric field to determine the angular distribution of prompt neutrons emitted in the fission of U^{235}. The ion chamber works on the principle that the time taken by the ions produced by an ionizing particle to arrive at the collecting plate of a plane parallel plate ion chamber is a measure of the cosine of the angle between the fission fragment and the electric field. (auth)

6992 A/CONF.15/P/1634
ON THE DETERMINATION OF THE SLOWING DOWN TIME IN BERYLLIUM OXIDE. R. Ramanna (Atomic Energy Establishment, Trombay, India). 4p.

The slowing down time and other diffusion constants of beryllium oxide were determined by various methods such as the method using diffusion cooling and the time-of-flight method using a pulsed source, and the measurement of the relaxation distance of low energy monochromatic neutrons. The values are found to be consistent. The possible errors in these measurements are discussed in detail, and the results are compared with the theory. (auth)

6993 A/CONF.15/P/1635
THE SLOWING DOWN OF NEUTRONS IN THE REGION OF 0.09 TO 0.0388 ev IN VARIOUS MODERATORS USING A MONOCHROMATIC BEAM. V. A. Gokhale, S. B. D. Iyengar, M. P. Navalkar, R. Ramanna, and N. Umakantha (Atomic Energy Establishment, Trombay, India). 7p.

A beam of monochromatic neutrons of 0.09 ev was selected from one of the beam holes of the swimming pool reactor, Apsara, using a sodium chloride crystal. This was allowed to fall on various moderating assemblies like graphite, beryllium oxide, lead, and water. The silver and cadmium ratios were measured at various points inside the moderator to determine the mean energies of the neutrons. The slowing down times in these moderators were computed from the measurements. (auth)

6994 A/CONF.15/P/1637
TRANSMISSION OF SLOW NEUTRONS THROUGH POLYCRYSTALLINE BERYLLIUM OXIDE. N. Sarma, K. Satyanarayana, C. S. Somanathan, and K. Usha (Atomic Energy Establishment, Trombay, India). 5p.

The variation of total scattering cross section with energy of beryllium oxide has been measured using a slow chopper neutron velocity spectrometer, and the results are compared with that of the only previous reported measurements of Fermi et al. in 1947. (auth)

6995 A/CONF.15/P/1638
TRANSPORT CROSS SECTION OF THERMAL NEUTRONS IN SOLID MODERATORS. K. S. Singwi and L. S. Kothari (Atomic Energy Establishment, Trombay, India). 22p.

Calculations on the variation of transport cross sections with neutron energy in beryllium, beryllium oxide, and graphite at room temperature were made. Assuming the equilibrium distribution of neutrons in the moderator to be Maxwellian, the average value of the diffusion coefficient $\overline{D}_s$ was calculated, from which the average value of the transport cross section is

deduced. In beryllium and beryllium oxide the contribution of the inelastic scattering to transport cross section has been taken into account, and it is shown that this makes a significant contribution to the average value of $\overline{D}_\phi$. In beryllium, the variation of $\overline{D}_\phi$ with the temperature of the moderator was studied. Transport cross section in graphite was calculated by taking only the elastic scattering into account and neglecting the contribution of the inelastic scattering, since the model chosen for the lattice vibrations of graphite makes the latter calculation rather unsatisfactory. (auth)

6996 A/CONF.15/P/1639
SLOWING DOWN OF NEUTRONS NEAR THERMAL EQUILIBRIUM IN BERYLLIUM AND BERYLLIUM OXIDE. L. S. Kothari and K. S. Singwi (Atomic Energy Establishment, Trombay, India). 5p.

Work is reported on the slowing down of neutrons in beryllium and beryllium oxide in the energy range where the effect of crystalline binding is important. For neutron energy less than $2k_\phi\Theta_D$, where k_ϕ is the Boltzmann constant and Θ_D is the Debye temperature, elastic and one-phonon inelastic cross sections are calculated on the Debye model by summing over the reciprocal lattice vectors, and the two-phonon cross section is calculated using the incoherent approximation. For neutron energy greater than $2k_\phi\Theta_D$, the Einstein model of a solid is used to calculate multiphonon cross sections. Mean energy loss per collision is evaluated in the two energy regions. Assuming that the neutron energy distribution is Maxwellian at all stages of the slowing down, the time variation of the temperature of this distribution has been calculated and the relaxation time of the slowing down process in the last stages determined. It is found that the mean energy loss per collision in beryllium is zero for neutron energy 800 k_ϕ. The neutron distribution approaches equilibrium at T = 304°K, with a relaxation time of 28μsec. In beryllium oxide the mean energy loss per collision goes to zero at neutron energy 840 k_ϕ. Neutron distribution approaches equilibrium at T = 310°K with a relaxation time of 67μsec. (auth)

6997 A/CONF.15/P/1691
MULTIPLE ISOTROPIC SCATTERING IN CONVEX HOMOGENEOUS MEDIA BOUNDED BY VACUUM. C. C. Grosjean (Univ. of Ghent). 32p.

In three preceding articles a new approximate formalism for solving one-velocity multiple-scattering problems in infinite homogeneous media was developed and studied in considerable detail. An extension of this formalism to the case of multiple isotropic scattering taking place in a convex homogeneous medium bounded by vacuum is presented. The scope and limitations of the present study are discussed. (W.D.M.)

6998 A/CONF.15/P/1692
MULTIPLE ISOTROPIC SCATTERING IN CONVEX HOMOGENEOUS MEDIA BOUNDED BY VACUUM. PART II. SOME PRACTICAL APPLICATIONS. C. C. Grosjean (Univ. of Ghent). 30p.

The approximation method developed in Part I is applied to a number of standard multiple scattering problems involving plane and spherical geometries, such as the albedo of half-space, reflection and transmission due to a slab of finite thickness, a point source in the center of a sphere, and a sphere with a uniform source distribution. Comparisons are made wherever possible with the corresponding results provided either by a rigorous treatment or by other approximation theories. (W.D.M.)

6999 A/CONF.15/P/1693
ETUDE DES DÉSINTÉGRATIONS NUCLÉAIRES PRODUITES DANS DES ÉMULSIONS NUCLÉAIRES PAR DES PROTONS DE 4- ET 6-BeV. (A Study of Nuclear Interactions in Emulsions Exposed to 4 and 6 Bev Protons). M. Morand, Y. Baudinet-Robinet, and L. Winand (Univ. of Liège). 20p.

A study was made of the stars produced in Ilford G_5 plates exposed to 4.2 and 6.25 Bev protons. The angular distributions of the secondary products were determined, with respect to the fine, grey, and black branches of the stars. The values of the forward backward ratios in the laboratory system are given. The integral distribution of the stars was determined as a function of the number of branches. The results are applied to an interpretation of cosmic radiation. (J.S.R.)

7000 A/CONF.15/P/1732
THE ELECTRON–NEUTRINO ANGULAR CORRELATION IN THE DECAY OF He^6. J. Csikai and A. Szalay (Hungarian Academy of Sciences, Debrecen). 20p.

The detection of the recoil effect of the neutrino in the β decay of He^6 by means of Wilson cloud chamber photographs is described. There were 381 measurable events found out of 4000 photographs. The angular correlation coefficient was determined to be $\alpha = +0.60 \pm 0.28$. (W.D.M.)

7001 A/CONF.15/P/1813
GAMMA-RAY FLUX MEASUREMENT IN RADIATIVE CAPTURE REACTIONS. I. PRELIMINARY WORK: THE REACTION $F^{19}(\alpha,p)\,Ne^{22}$. J. da Veiga Simão (Instituto de Alta Cultura Centro de Estudos de Fisica, Coimbra, Portugal). 6p.

Through the analysis of the proton yield curves resonances were found at various alpha energies. The magnetic analysis of the protons at various resonances yielded Q values of 1.704 ± 0.010 and 0.434 ± 0.010 Mev for the reaction. Gamma spectra were studied at several proton resonances. Angular distributions of protons and gamma rays as well as angular correlations between the protons and gammas were measured. The calculated gamma flux at several resonances is given. (W.D.M.)

7002 A/CONF.15/P/1962
EFFECT OF COSMIC RAYS ON MATTER. H. Wänke (Max-Planck-Inst. für Chemie, Mainz). 6p.

The helium and neon content of a number of iron meteorites was analyzed. Some stable isotopes of solid elements were investigated as possible products of the impact of cosmic rays. Using the neutron activation technique, the scandium-45 content of three iron meteorites was investigated and found to be proportional to the helium content. (W.D.M.)

7003 A/CONF.15/P/1964
ENERGETIC HEAVY FRAGMENTS EMITTED FROM NUCLEAR STARS. Shigeo Nakagawa, Eiji Tamai, and Shoji Nomoto (Rikkyo Univ., Tokyo). 22p.

The heavy nuclear fragments ($Z \geq 3$) emitted in the cosmic-ray stars of heavy nuclei (Ag, Br) in emulsion were investigated by the method of charge determination which was carried out by measuring their track width. It was found that a majority of the fragments were ejected by the nuclear evaporation process, but there was a small number of energetic fragments not explained by this process. Stars induced by 6.2-Bev protons from the Bevatron were studied. The charge dis-

tribution, angular distribution, and energy spectra of the fragments were determined. (W.D.M.)

7004 A/CONF.15/P/1971
EXCITED STATES IN EVEN-EVEN NUCLEI WITH $40 \leq A \leq 154$ AND $180 \leq A \leq 226$. C. A. Mallmann Comisión Nacional de Energía Atómica, Buenos Aires). 12p.

A review is made of the experimental information available on the excited levels for even-even nuclei in the ranges $40 \leq A \leq 154$ and $180 \leq A \leq 226$ and a representation of the relevant findings is presented as a function of N and Z. The properties common to all levels are reviewed and the discrepancies observed are stressed. (auth)

7005 A/CONF.15/P/2029
THERMAL-NEUTRON CAPTURE GAMMA-RAY SPECTRA AND NUCLEAR LEVEL DISTRIBUTION. L. V. Groshev, A. M. Demidov, et al. (U.S.S.R.). 36p.

The results of experimental studies of thermal neutron capture γ-ray spectra are reported. Gamma rays in the 0.3 to 12 Mev energy range were investigated using a magnetic Compton spectrometer with ~2% resolution. Gamma spectra of about 40 elements were measured. The dependence of the gamma spectrum shape on the level density, their distribution, and characteristics is discussed. (auth)

7006 A/CONF.15/P/2030
FAST NEUTRON SCATTERING AND CAPTURE BY ATOMIC NUCLEI. M. V. Pasechnik, I. F. Barchuk, et al. (U.S.S.R.). 31p.

A summary of results obtained in the study of elastic and inelastic scattering and capture of fast neutrons by atomic nuclei, from the point of view of reactor physics and nuclear interaction theory, is presented. Some results are reported of inelastic scattering cross section measurements for monochromatic 2.5 to 4.3 Mev neutrons and inelastic collision 14 Mev neutron cross sections. Limits were established for the cross sections of (n,2n) reactions arising as a result of nuclei being bombarded by 14 Mev neutrons. (auth)

7007 A/CONF.15/P/2031
SPECTRUM OF FRAGMENTS OF Pu-240 SPONTANEOUS FISSION. T. A. Mostovaya (U.S.S.R.). 10p.

The results of energy distribution measurements for fragments from Pu^{239} and Pu^{240} fission induced by neutrons with energies corresponding to the known levels within the region from 0 to 10 ev are reported and compared. For fragment energy measurements a grid ionization chamber with an amplitude analyzer was used. Selection of fission events induced by monochromatic neutrons was made by means of a mechanical velocity selector and a time analyzer. The results of fragment energy distribution measurements are given for spontaneous and induced fission. The experimental data obtained are discussed according to modern conceptions of the fission process. (auth)

7008 A/CONF.15/P/2033
ON THE FORMATION OF A THERMAL-NEUTRON SPECTRUM. S. I. Drozdov, D. F. Zaretskii (Zaretsky), et al. (U.S.S.R.). 27p.

The angular and energy distribution function for slow neutron scattering in a hydrogenous medium is discussed. The dependence of the thermal neutron spectrum in an absorbing and moderating medium on the form of the distribution function is considered. A calculation of the principal characteristics of the slow neutron distribution function for scattering in para- and orthohydrogen is presented. Particularly, the results of numerical calculations and asymptotic estimates show that the mean energy loss per one collision and the total scattering cross section attain the limiting values corresponding to the neutron scattering by free nuclei if the neutron energy is comparable with the first rotational energy level. A phenomenological description of the neutron scattering process in water is given, the concept of an effective mass being used. The transport length is calculated as a function of the water temperature. A variational method of determining the neutron gas effective temperature is developed. It is shown that for small absorption the effective temperature is determined by first energy moments of the angular and energy distribution function. (auth)

7009 A/CONF.15/P/2037
THE ANGULAR DISTRIBUTION OF FISSION FRAGMENTS IN THE PHOTOFISSION OF U^{238}. A. I. Baz, N. M. Kulikova, et al. (U.S.S.R.). 13p.

The angular distribution of photofission fragments from U^{238} was measured using the x-ray beam from a 30-Mev synchrotron at five maximum energies: 6.5, 8, 9.4, 12, and 26.5 Mev. (L.T.W.)

7010 A/CONF.15/P/2040
MASS-SPECTROSCOPIC STUDIES OF FISSION PRODUCTS OF URANIUM-233, URANIUM-235 AND PLUTONIUM-239. M. P. Anikina, P. M. Aron, V. K. Gorshkov, et al. (U.S.S.R.). 8p.

Yields of some U^{233}, U^{235}, and Pu^{239} fission products produced by thermal neutrons were determined using the mass spectrometer. The results were used for calculating the values of neutron capture cross sections for a number of nuclei and for determining the half lives of individual isotopes. (auth)

7011 A/CONF.15/P/2147
THE STUDY OF SPATIAL AND ENERGETIC DISTRIBUTION OF NEUTRONS IN VARIOUS MEDIA. D. L. Broder, S. A. Kurkin, et al. (U.S.S.R.). 38p.

The neutron space-energy distributions in graphite, boron carbide, iron, water, and 6 iron–water mixtures were studied. Measurements were carried out up to thickness of about 10 to 15 neutron free path lengths. A method of calculation was developed for space-energy distributions in inelastically scattering media. The elastic scattering anisotropy was taken into account when the neutron free path was an energy function. (W.D.M.)

7012 A/CONF.15/P/2149
NEUTRON-INDUCED FISSION CROSS SECTIONS OF Th^{232} AND U^{238} IN THE ENERGY RANGE OF 3 TO 11 Mev. NEUTRON-INDUCED FISSION CROSS SECTIONS OF U^{233}, U^{235}, Np^{237}, AND Pu^{239} IN THE ENERGY RANGE OF 3 TO 8 Mev. S. P. Kalinin and V. M. Pankratov (U.S.S.R.). 20p.

The fast fission cross sections of Th^{232}, U^{233}, U^{235}, U^{238}, Np^{237}, and Pu^{239} were measured in the 3 to 12 Mev energy interval. The neutron flux was measured by a proportional counter and by a scintillation counter using time-of-flight techniques. At neutron energies from 5 to 7 Mev all cross sections measured show a rise, the relative magnitude of which is greater the less the cross section in the region from 3 to 5 Mev. (auth)

7013 A/CONF.15/P/2187
AVERAGE NUMBER AND SPECTRUM OF PROMPT NEUTRONS IN FAST NEUTRON-INDUCED FISSION.

I. I. Bondarenko, B. D. Kuzminov, et al. (U.S.S.R.). 28p.

Descriptions are given of the methods used for measuring the average number and spectra of prompt neutrons emitted in fast fission of Th^{232}, U^{233}, U^{235}, U^{238}, Np^{237}, and Pu^{239}. The dependence of the fission neutron spectrum on the excitation energy and A and Z values of fissionable nuclei is discussed. (W.D.M.)

7014 A/CONF.15/P/2219

MEASUREMENTS OF RADIATIVE CAPTURE CROSS SECTIONS FOR FAST NEUTRONS. A. I. Leipunskii (Leipunsky), O. D. Kazachkovskii (Kazachkovsky), G. Y. Artyukov, et al. (U.S.S.R.). 26p.

Cross-section measurements of radiative capture were made both for monoenergetic fast neutrons and for a wide spectra of fast neutrons by means of an activation method, as well as by neutron balance in the spherical geometry of the experiment, by capture γ rays, and by reactivity measurements. Measurements of capture cross sections for a number of elements, including natural isotopic mixtures, were carried out by the method of neutron balance in spherical geometry, using photoneutron sources. In order to measure capture cross sections of natural isotopic mixtures and isotopes which cannot be activated, a method was developed involving capture γ ray measurements. Gamma radiation was registered by scintillation counters with naphthalene and fluorite crystals. By a method of activation (by induced β activity) capture cross sections were measured by using neutron reactions $T(p,n)He^3$ and D-D as sources. Measurements were made by means of comparison with capture cross sections of thermal neutrons. A similar method was used for Sb-Be photoneutron capture cross section measurement. Radiative capture cross sections of a large group of isotopes were measured by the method of reactivity (natural isotopic mixtures) and by the activation method (activated isotopes). In the core of the fast reactor BR-1 the effective absorption of neutrons by various elements was measured by the global oscillator method. The neutron capture cross sections for the fission spectrum were measured for a large group of isotopes by the activation method, as well as for the neutron spectra in the core center and in the reflector of a fast reactor. The results which were obtained in the experiments described are discussed in accordance with the shell model and statistical theory. (auth)

7015 A/CONF.15/P/2221

SOME NEW RESEARCH DATA ON EFFECTIVE CROSS-SECTIONS AND FISSION PROCESS. (REVIEW). (PRELIMINARY REPORT). V. V. Vladimirskii (Vladimirsky), I. V. Kirpichnikov, et al. (Academy of Sciences U.S.S.R.). 32p.

A summary is given of some new data on neutron effective cross sections and level parameters for U^{235}, U^{233}, Pu^{239}, Np^{237}, Th^{229}, Pu^{238}, and Pu^{240}. Data are cited of fission cross sections and the dependence of secondary neutron numbers on the primary neutron energy. For some nonfissionable elements data are cited on the dependence of radiation capture on energy. Level parameters are given, and some results of γ-ray spectrum measurements, which accrue from capture of neutrons on various levels are discussed. Results are described of fission induced by μ mesons. The review is a compilation of reports on research work carried out in the USSR. (auth)

7016 A/CONF.15/P/2222

DELENIE YADER SEREBRA PROTONAMI BOL'SHOI ENERGII. (The Character of Proton-Induced Ag and Br Nuclei Fission at Ep = 180-660 Mev.) V. P. Shamov (U.S.S.R.). 12p.

Nuclear fission in the elements located in the middle of the periodic system was studied by the method of thick-layered nuclear emulsions. The experiments were made with a proton beam with energy from 180 to 660 Mev. The characteristics of the fission process for Ag and Br nuclei, the dependence of fission cross section on the incident proton energy, the character of the fission from the viewpoint of process asymmetry, and the energy spectra and angular correlation of the charged particles associated with fission were investigated. The formation cross section for fragmentation products associated with the fission process is described. The single dependence obtained characterizes the yield of residual nuclei, according to Z, in different nuclear processes such as evaporation, fragmentation, and fission. Comparative characteristics are presented for Ag and Br fission processes and for nuclei, as Bi and U, located at the end of the periodic system. (J.S.R.)

7017 A/CONF.15/P/2223

EVALUATION OF THE ABSORPTION CROSS SECTION OF U-235 FISSION FRAGMENTS IN THE $0.025 - 10^6$ ev ENERGY RANGE AND CALCULATION OF FRAGMENT EFFECTS IN INTERMEDIATE REACTORS. I. V. Gordeev and V. Ya. Pupko (U.S.S.R.). 29p.

The neutron absorption cross sections of those U^{235} fission fragments whose radiative-capture thermal cross section does not exceed 10^3 barns are evaluated. Non-stable fragments of half life less than 100 days were not considered. Results were used to calculate the effect of fragments on intermediate reactor reactivity. The calculations were carried out for non-reflected reactors in the diffusion-age approximation. (W.D.M.)

7018 A/CONF.15/P/2227

O DELENII YADER μ MEZONOM. (On μ-Mesonic Fission.) D. F. Zaretskii (Zaretsky) (U.S.S.R.). 11p.

The possibility of nuclear fission as the result of μ-meson non-radiative transition from the 2p into the 1s state in mesonic atoms is considered. As a result of such transition the nucleus is excited. The energy of excitation is equal to the difference in the energy of the levels mentioned. For nuclei of the uranium region, this transition energy exceeds the fission barrier by a value of the order of 1 Mev. The probability of non-radiative nuclear excited is evaluated with regard to the probability of γ emission. This ratio is found proportional to the electrical dipole component of photoeffect cross section. The possibility of μ-meson fission catalysis is discussed as well. (auth)

7019 A/CONF.15/P/2272

ON THE DIFFUSION OF NEUTRONS IN MODERATING AND MULTIPLYING MEDIA WITH A PERIODICAL NEUTRON SOURCE. Gerhard Jacob (Inst. de Energia Atômica, São Paulo, Brazil). 16p.

The symbolic calculation method developed by Gallone and Salvetti is applied to the study of the spatiotemporal distribution of thermal neutrons in moderating and multiplying media with a fast neutron source varying according to a sine function of the time. Using a Fourier transform, the general case of a pulsed fast neutron source of any shape is considered, and an application is made to the special case of a triangularly shaped fast neutron pulse produced in a spherical, circular cylinder, or a parallelepiped multiplying medium. (auth)

7020 A/CONF.15/P/2299
HEAVY ION REACTIONS. G. N. Flerov (U.S.S.R.). 22p.

A brief review is presented of the work already completed and of the possible lines of research on nuclear reactions produced by multiple charged ions. The wide range of applications for heavy particles in the solution of a series of interesting problems is discussed. The creation of special accelerators to produce intense beams of high-energy heavy ions will considerably enlarge the experimental facilities in new element production and the study of highly excited nuclei with extremely high rotational angular momenta. (W.D.M.)

7021 A/CONF.15/P/2337
SCATTERING OF α PARTICLES OF 37.93 MeV BY C^{12} AND F^{19}. J. Catala, J. Aguilar, and L. Miralles (Univ. de Valencia and Junta de Energia Nuclear, Madrid). 10p.

The elastic scattering of 38-Mev alpha particles from a carbon tetrafluoride target was investigated to determine the angular distributions corresponding to the diffusion of the alpha particles in C^{12} and F^{19}. These distributions were analyzed, and the nuclear radii were deduced. The experimental technique and the method of distribution analysis are described. (J.R.D.)

7022 A/CONF.15/P/2463
NOTES ON TWO ANTIMONY ACTIVITIES HAVING MASS NUMBER 126. Horacio E. Bosch and Renato Radicella (Comision Nacional de Energia Atómica, Buenos Aires.) 9p.

Two Sb^{126} activities were observed starting from fast neutron irradiation of Te^{126}: one of 18.8 min and the other of about 6 days. Gamma spectra for the two antimony activities and for I^{126} are presented. (W.D.M.)

7023 A/CONF.15/P/2464
GAMMA RADIATION FROM I^{128}. H. Bosch, R. Radicella, et al (Comisión Nacional de Energía Atómica, Buenos Aires). 7p.

The decay of I^{128} was investigated. The method of source preparation is described, along with the technique of measurement. It was concluded that the disintegration produces four gamma rays, the intensities of which are listed. The energies of the first excited levels of some Xe and Te nuclides are given. (J.R.D.)

7024 A/CONF.15/P/2467
THE FISSION PROCESS—MECHANISMS AND DATA. R. B. Leachman (Los Alamos Scientific Lab., N. Mex.). 42p.

The purpose of this review is to examine briefly many of the aspects of the fission process by particularly considering fission induced by excitations up to tens of Mev. Greater bombarding energies involve uncertainties in the nature of the deposition energy that are apart from the fission process itself. Results of neutron-induced fission are considered, partly because of simplicities of barrier penetration and absorption into nuclear matter and because of the practical importance of neutron-induced fission in this energy range. (W.D.M.)

7025 A/CONF.15/P/2467(Add. 1)
THE FISSION PROCESS—MECHANISMS AND DATA. R. B. Leachman (Los Alamos Scientific Lab., N. Mex.). 6p.

Although data show that at least seven periods contribute to the gross decay of delayed neutrons, the gross decay from many different fissioning nuclei can accurately be fitted by only six decay periods. These have only small variations from one fissioning nucleus case to another. (W.D.M.)

7026 A/CONF.15/P/2472
PHOTOFISSION CROSS SECTIONS NEAR THE THRESHOLD OF (γ,n) REACTIONS. A. I. Baz and Ya. A. Smorodinskii (Smorodinsky) (U.S.S.R.). 11p.

It is believed the (γ,n) reaction threshold energies for Th^{232}, U^{235}, and U^{238} lie in the energy region close to 6 Mev. Simple formulas which described this effect are presented. (W.L.H.)

7027 A/CONF.15/P/2473
OB ENERGII VOZBUZHDENIYA OSKOLKOV PRI DELENII YADER. (Excitation of Energy of Fragments from Nuclear Fission.) B. T. Geilikman (U.S.S.R.). 11p.

The dependence of fragment energy on the ratio of fragment masses, A_1/A_2, for a given nucleus and on the Z and A of the fissioned nucleus was analyzed. (R.V.J.)

7028 A/CONF.15/P/2477
RESEARCH IN NEUTRON-DEFICIENT RARE EARTHS. A. Bashilov, K. Gromov, et al. (Leningrad State Univ.). 25p.

A study of neutron-deficient rare earths obtained by 680-Mev proton irradiation of Ta is reported. The following new isotopes were discovered: Eu^{146}, Gd^{146}, Gd^{147}, Dy^{153}, Dy^{155}, Ho^{155}, Tm^{161}, and Lu^{167}. Mass numbers were established by studying genetic bonds with the aid of multiple extractions of daughter fractions. Decay schemes are given for Gd^{146}, Gd^{147}, Gd^{149}, Gd^{151}, Eu^{146}, Eu^{147}, Tb^{153}, Tb^{155}, Ho^{160}, Tm^{168}, Tm^{167}, Tm^{168}, Lu^{171}, and Lu^{173}. (W.D.M.)

7029 A/CONF.15/P/2513
SYSTEMATICS OF THE GROUND STATE ROTATIONAL BAND IN EVEN-EVEN NUCLEI WITH $158 \leq A \leq 182$ AND $230 \leq A$. W. Scheuer and E. Aisenberg (Comisión Nacional de Energía Atómica, Buenos Aires). 44p.

A great quantity of work dealing with the systematization of the properties of the excited states of even-even nuclei has been done up to the present. This paper is an extension of a presentation on "Energy systematics of the excited states of the ground state rotational band in even-even nuclei with $90 \leq N \leq 114$ and $56 \leq Z \leq 74$" made before the 30th meeting of the Argentine Association of Physics (1957). The systematics of some properties of the rotational level scheme type nuclides with $40 \leq A$ are studied. (W.D.M.)

Theory

7030 A/CONF.15/P/573
ON A NEW METHOD FOR SOLVING THE BOLTZMANN EQUATION IN NEUTRON TRANSPORT THEORY. Olav Aspelund (Joint Establishment for Nuclear Energy Research, Kjeller, Norway). 14p.

In analogy with the spherical harmonics method which is based on the use of the Legendre Polynomials and their orthogonal properties, a new method is developed for solving the Boltzmann equation. The new method consists in the consistent use of the Tschebyscheff Polynomials of the first class. These orthogonal polynomials have remarkable convergence and approximation properties, and their merits in neutron transport theory are compared with the Legendre Polynomials. Some examples of their use are given, and a new approximation scheme analogous to the Wick's method is developed. (auth)

7031 A/CONF.15/P/1087
SHORT RANGE FORCES AND NUCLEAR SHELL THEORY. MATRIX ELEMENTS IN L S COUPLING. Marcos Moshinsky (Univ. de Mexico and Inst. Nacional de la Investigación Cientifica, Mexico D. F.). 29p.

A procedure is developed for obtaining in nuclear shell theory the matrix elements associated with short-range interactions between nucleons. It is shown that potentials of arbitrary range, both central and spin dependent, can be developed in terms of a series of velocity-dependent potentials in increasing powers of the momentum, but all of zero range. All the matrix elements are obtained for two nucleons in the same shell and in LS coupling, up to terms containing the first moment of the potential. The matrix element is compared for central, spin-orbit, and tensor forces. (W.D.M.)

7032 A/CONF.15/P/1331
INTERACTION OF BETA DECAY. Seitaro Nakamura (Tokyo Univ.). 7p.

In studying the beta decay interaction, the analyses of the shapes of the beta spectra in the forbidden transitions together with the knowledge on the angular correlation of the particles emitted in the beta decays need to limit the possible combinations of the fermi interactions to three cases. The structure of the spin and charge conjugation of the neutrino was studied and compared with recent experiments. The hypothetical heavy meson is proposed to exist which is intermediate between the weak interaction of beta decay and the strong interaction of the electron-nucleon hard core. (W.D.M.)

7033 A/CONF.15/P/1334
ON THE APPLICABILITY OF PION-THEORETICAL NUCLEAR POTENTIAL. S. Otsuki (Nagoya Univ., Japan), R. Tamagaki (Kyoto Univ.), and W. Watari (Osaka City Univ.). 12p.

The consequences of the theoretical pion potential in nucleon interactions at 90 and 150 Mev are discussed. The conclusion drawn is that at these energies no evidence is found for the serious modification of the static theoretical pion potential. It can be expected that most features of the low-energy potential remain unchanged at intermediate energies, though some are lost. (W.D.M.)

7034 A/CONF.15/P/1481
NUCLEAR LEVEL DENSITY. M. El-Nadi and M. Wafik (Egyptian Atomic Energy Commission, Cairo). 16p.

Fong in his study of the problem of asymmetric fission applied Hurwitz-Bethe hypotheses to nuclei in the fission product region. This technique has succeeded in showing the applicability of the Fermi gas model to nuclei in this region. The work of Fong is extended by carrying out the calculations for nearly all mass numbers between 10 and 250, including the fission product region. The liquid drop model mass formula is corrected for each nuclide. The position of the characteristic level is determined. Analyzing the experimental data of fast neutron capture cross sections and using the above device, the Fermi gas model formula is tested and the value of its parameters are determined. The results and their implications are discussed. (W.D.M.)

7035 A/CONF.15/P/1710
STATISTICAL FLUCTUATIONS OF NEUTRON MULTIPLICATION. L. I. Pál (Central Research Inst. for Physics, Budapest). 42p.

Statistical fluctuations of neutron multiplication are due partly to fluctuations in the number of neutrons produced by the fission process and partly to fluctuations in the duration of the chain reaction process. Relations are deduced for defining the statistical fluctuations of neutron multiplication by using a procedure of more general character than that given by Hoffmann. The possibilities to be realized by use of the more general procedure are indicated. It is assumed that the multiplying medium is infinite and that spatial distribution of different atomic nuclei within it is uniform. (W.D.M.)

7036 A/CONF.15/P/1970
ON THE REDUCTION OF THE γ_a-ALGEBRA. Sorin Ciulli (Joint Institute for Nuclear Research, Moscow). 8p.

Starting from the problem of covariantly writing down the independent scattering matrix terms for various processes in which pairs are created or destroyed, the reduction, in the group theoretical meaning, of the sixteen dimensional algebra of the γ_a matrices to that corresponding to processes which conserve the number of nucleons is considered. A simple practical form is given for this reducing procedure of the sixteen initial γ_a units to the four dimensional basis of the subspace of interest. (W D.M.)

7037 A/CONF.15/P/2249
INVESTIGATIONS OF THE MANY-BODY PROBLEM AND THEIR APPLICATION TO THE THEORY OF NUCLEAR MATTER. N. N. Bogolubov (U.S.S.R.). 13p.

Methods developed for studying the many-body problem are widely used in various aspects of modern physics. The problem of ascertaining the specific properties of correlation structure and its influence on the formation, from particles, of a bound system possessing fluidity is a rather important one. Typical examples are those of helium superfluidity and superconductivity which may be considered as superfluidity of electrons in metals, if microscopic effects caused by a magnetic field are disregarded. The characteristic features of heavy nuclei energy distribution give reasons to suppose that the structure of nuclear matter is similar, to a certain extent, to the electronic structure of superconducting metals. Data concerning the investigation of the properties of nuclear matter possessing superfluidity are presented. (auth)

7038 A/CONF.15/P/2474
ON THE ASYMMETRY OF NUCLEAR FISSION. B. T. Geilikman (U.S.S.R.). 17p.

Various explanations of the asymmetry of nuclear fission are reviewed, along with a mathematical development of the subject. It is pointed out that no claim of great accuracy is made; however, some relationships are deduced, such as the dependence between the energy of the initial nucleus and asymmetric deformation just before neck scission and the importance of the region in the vicinity of the neck scission point in the mass division. The shell effect is also considered. (J.R.D.)

RADIATION EFFECTS ON MATERIALS

7039 A/CONF.15/P/28
THE EFFECT OF NEUTRON IRRADIATION ON THE MECHANICAL PROPERTIES OF GRAPHITE. H. W.

Davidson and H. H. W. Losty (General Electric Co., Ltd., Wembley, Eng.). 24p.

The effect of neutron irradiation on the elastic modulus, breaking strength, internal friction, and specific resistance of amorphous and graphitized carbon artifacts was examined experimentally. Facilities made available by the U.K. Atomic Energy Authority have been used to obtain irradiation doses of about 10^{20} nvt at temperatures varying from 100 to 300°C. The effect of irradiation on spring specimens maintained at constant strains (of the order of 10^{-3}) are also described. These specimens were made from petroleum coke and examined before and after graphitization. The permanent sets induced cannot be accounted for by Simmons' 'locked strain' theory but are considered as a relaxation of stress. A few similar experiments on the relaxation of strain at constant stress are being carried out. Diagrams illustrating the thermal annealing of these irradiation effects and those of the 'permanent sets' are presented. These results are discussed against the background of stress-induced and thermally activated slip mechanisms studied under out-of-pile conditions. (auth)

7040 A/CONF.15/P/29
THE EFFECT OF GASES PRODUCED IN REACTOR MATERIALS BY IRRADIATION. R. S. Barnes and G. W. Greenwood (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 14p.

Neutron bombardment produces gases in reactor fuels and in some materials which may be used for cans, moderator, control elements, or coolant. The gas producing reactions of most significance are listed. Gas production can alter radically the properties of the material; if the material is brittle it will eventually fragment or, if plastic, its volume will increase. Some examples of fragmentation are given and its importance in reactor materials is discussed. Helium injected into plastic metals precipitates in a great number of small bubbles on subsequent heating. It is considered that these bubbles form when the helium atoms occupy vacancies which have migrated from nearby sources such as grain boundaries. The bubbles grow on further heating and though their number generally decreases there is a resultant increase in the volume of the material since the restraint imposed by surface tension is less for the larger bubbles. In metallic reactor fuels at about 800°C the volume increase agrees with that estimated from the creep strength of the material but at lower temperatures the volume increase is greater than that estimated on the same basis. It is suggested that a process of vacancy condensation occurs which enhances bubble growth. Several examples of the precipitation of gas bubbles in solid materials are given and the significance of this phenomenon for reactor materials is discussed. (auth)

7041 A/CONF.15/P/50
FUEL ELEMENT BEHAVIOUR UNDER IRRADIATION. V. W. Eldred, G. B. Greenough, and P. Leech (United Kingdom Atomic Energy Authority, Sellafield, Cumb., Eng.). 23p.

Changes which occur in fuel elements during irradiation in the Windscale or Calder Hall reactors are described. Particular attention is paid to behavior of the natural uranium fuel. Surface wrinkling is shown to be dependent on irradiation temperature as well as grain size. The microstructure of irradiated material is described. The slight decreases in density that occur also vary with irradiation temperature and are partly due to the development of small irregular voids in the metal. Changes in length and diameter are normally very small. Of special interest is the bowing of vertically stacked Calder Hall fuel elements. It is shown that the cartridges bow at a rate in agreement with the original predictions. Examination of aluminum cans after irradiation has revealed a slight increase in hardness but otherwise little change. The magnesium alloy used for the Calder Hall cans does not increase in hardness under similar conditions but may develop small grain-boundary voids if slowly strained, especially at low temperatures. A brief summary is given of some of the important causes of the cartridge failures that have been examined. (auth)

7042 A/CONF.15/P/80
THE MECHANICAL PROPERTIES, EMBRITTLEMENT AND METALLURGICAL STABILITY OF IRRADIATED METALS AND ALLOYS. M. J. Makin, D. R. Harries, R. E. Smallman (Atomic Energy Research Establishment, Harwell, Berks, Eng.), and A. T. Churchman (Associated Electrical Industries, Ltd., Aldermaston, Berks, Eng.). 26p.

The change in the tensile properties on irradiation of a number of metals of use as reactor constructional materials is described in detail. Materials tested include titanium, zirconium, Zircaloy-2, molybdenum, tungsten, mild steel, nickel, copper, and certain magnesium alloys. In general, the results indicate an increase in yield and ultimate strength and a decrease in elongation to fracture. (auth)

7043 A/CONF.15/P/113
ACTION DU RAYONNEMENT GAMMA ET DES NEUTRONS SUR LES CRISTAUX MOLECULAIRES ET IONIQUES PAR SPECTROSCOPIE NUCLEAIRE QUADRIPOLAIRE PURE. (Effects of Gamma Rays and Neutrons on Molecular and Ionic Crystals, as Ascertained by Pure Quadrupolar Nuclear Spectroscopy.) Jules Duchesne (Univ. of Liège, Cointe-Sclessin, Belgium). 11p.

Work recently carried out established that very low concentrations of a substance (an impurity) can be detected in a solid solution by the analysis of the quadrupolar spectrum which characterizes the more abundant compound. It was shown that there is a relationship when the impurities are caused to appear in the matter by radiations of various types (for instance the gamma rays produced by Co^{60}, and neutrons). A simple method which does not in any way affect the samples but which is limited by the requirement that good quality spectra be obtained was developed in order to arrive at some estimate of the relevant damage (chemical transformations and lattice defects). It was applied, in particular, to the determination of the resistance of some molecular and ionic crystals to radiation (aromatic and alicyclic halogenated derivatives, iodoform, and sodium chlorate). The results obtained provided a base for discussion of the problem of the relationships between the molecular structure and radiation resistance, as well as a review of the questions related to the recovery phenomena and the oxygen effect. (auth)

7044 A/CONF.15/P/141
THERMAL CONDUCTIVITY OF UO_2. K. Berg, J. E. Flinta, and L. Seltorp (AB Atomenergi, Stockholm). 9p.

The heat transfer coefficient of UO_2 and its dependence on the thermal load, and on the neutron irradiation was investigated. UO_2 of different densities produced by

various methods was used. Thermal load was produced by electrical heating. The neutron irradiation was done in the research reactor R1. (auth)

7045 A/CONF.15/P/190
EFFECTS OF NEUTRON IRRADIATION ON MECHANICAL PROPERTIES OF FERRITIC STEELS AND IRONS. L. P. Trudeau (International Nickel Co. of Canada, Ltd., Toronto and Atomic Energy of Canada Ltd., Chalk River, Ont.). 11p. (AECL-600). $0.25(AECL).

The effect of fast-neutron irradiation at 50 to 70°C on the mechanical properties of some ferritic steels and irons was investigated with particular emphasis on the correlation between the magnitude of irradiation damage and the composition and microstructure. Impact energy transition curves, and tensile-test results are reported for sub-sized specimens; the correlation between results for sub-sized samples and those for full-sized samples is given for unirradiated material. U.S. Navy HY65 alloy (a nickel–molybdenum–vanadium–copper low-carbon steel) was examined in three conditions of heat-treatment; normalized and tempered, austempered and tempered, and quenched and tempered. The third condition was the least susceptible to irradiation damage. Samples of five ferrites (carbon contents of 0.013 to 0.024%) containing 3.2% Ni, 1.5% Mn, 1.0% Cr, and 0.5% Mo have been irradiated for different times. After irradiation the brittle-ductile transition temperatures of these materials approached that of unalloyed ferrite. The increase in yield strength for a given irradiation was about 10% higher for nickel than for manganese ferrites; in turn, the value for the latter material was about 10% higher than for unalloyed and chromium ferrites. The tensile properties of the molybdenum ferrite were least affected by irradiation. (auth)

7046 A/CONF.15/P/191
IRRADIATION EXPERIENCE WITH RODS OF PLUTONIUM–ALUMINUM ALLOY. O. J. C. Runnalls (Atomic Energy of Canada Ltd., Chalk River, Ont.). 22p. (AECL-601.) $0.25(AECL).

Results of irradiations of plutonium fuel rod designs are examined. The three such designs tested include: doubly-canned plutonium–aluminum alloys in an assembly 300-cm long, with an approximately sine-squared distribution of plutonium; a design in which uranium metal was substituted at each end of the rod for the dilute alloys which were contributing little excess reactivity; and a third design consisting of a stack of twelve cast and machined aluminum alloy cylinders containing 265 g of plutonium as a 3.7 wt.% dispersal. Ten assemblies of the last design are at present in the NRX Reactor for enrichment and to produce a source of higher isotopes of plutonium for reactor physics studies. (J.R.D.)

7047 A/CONF.15/P/193
BEHAVIOUR OF URANIUM OXIDE AS A REACTOR FUEL. J. A. L. Robertson, A. S. Bain, A. H. Booth, J. Howieson, and R. F. S. Robertson (Atomic Energy of Canada Ltd., Chalk River, Ont.) and W. G. Morison (Hydro-Electric Power Commission of Ontario). 46p. (AECL-603). $0.25(AECL).

Observations on complete pellets, fractured surfaces, and polished sections showed that uranium oxide, irradiated at temperatures below its melting point, exhibits grain growth, cracking, void formation, and other mass movement. These phenomena are affected by the fuel diameter and density, the heat rating, the initial clearance between fuel and sheath, the atmosphere within the sheath, and the oxygen–uranium ratio of the oxide. The amount of fission-product gas that emanates from the oxide was observed by analysis of the gas released from a defected sheath during irradiation, and by analysis of the gas inside an undefected sheath after irradiation. In these irradiations and auxiliary laboratory studies the gas release was related to a simple diffusion model, characterized by a particle size. The program is directed towards reducing fuelling costs, and methods of fabrication are being explored that are cheaper than the established process of sintering in hydrogen. (auth)

7048 A/CONF.15/P/235
THE USE OF THERMOLUMINESCENCE FOR DOSIMETRY AND IN RESEARCH ABOUT THE RADIATION AND THERMAL HISTORY OF SOLIDS. N. Grögler, F. G. Houtermans, and H. Stauffer (Univ. of Bern). 6p.

A method has been developed for the measurement of thermoluminescence glow-curves in natural minerals as well as in rocks, meteorites, and artificially irradiated solids. The method consists in flash heating at about 100°C/sec. The light intensity is measured with a photomultiplier as a function of time or temperature. An exact description of the apparatus is given. (W.D.M.)

7049 A/CONF.15/P/998
ON THE THEORY OF RADIATION DAMAGE AND RADIATION HARDENING. Alfred K. Seeger (Max-Planck-Inst. für Metallforschung, Stuttgart and Technischen Hochschule, Stuttgart). 52p.

A theory of radiation damage of nonfissionable material is developed, which attempts mainly to explain the phenomena of radiation hardening. It is shown that these can be accounted for quantitatively in the following way: each fast knock-on atom creates a disturbed "zone" at the end of its trace; these zones harden the material, since they have to be cut by dislocation lines; and this gives the observed temperature dependence of the critical shear stress of neutron-irradiated copper crystals and also the observed annealing behavior of radiation hardening. The recovery of electrical resistivity after irradiation is interpreted as follows (using copper as an example): the low temperature recovery (at about 40°K) after neutron bombardment is due to atomic rearrangements in the "zones," whereas after electron bombardment it is due to the recombination of very close pairs of vacancies and interstitial atoms; isolated interstitial atoms are able to migrate in the temperature region at about 240°K, whereas vacancies can migrate only above room temperature. (auth)

7050 A/CONF.15/P/998(Add.1)
ON THE THEORY OF RADIATION DAMAGE AND RADIATION HARDENING. Alfred K. Seeger (Ger.) 10p.

Work hardening and slip mechanisms of irradiated metal single crystals are discussed. (W.L.H.)

7051 A/CONF.15/P/1294
L'ACTION DES RADIATIONS IONISANTES SUR LES MACROMOLECULES SYNTHETIQUES POLYELECTROLYTIQUES. (The Chemical Modifications of the Exchange Resins Under the Action of Ionizing Radiation.) O. Costăchel and G. Furnică (Inst. Oncologique, Bucharest). 24p.

The modifications in the chemical and physical properties of various exchange resins exposed to ionizing radiation were studied. The characteristics considered

were the total exchange capacity, the index of acidity, degree of absorption, and solubility. The effect of chemicals, such as cysteamine, was also determined. The results showed that the macromolecules of the resins show direct and indirect effects of ionizing radiation. The chemical and reticular structure is modified. The indirect effect of radiation can be diminished by the presence of chemical substances with an affinity for the radiolytic radicals formed in the water. (J.S.R.)

7052 A/CONF.15/P/1346
RADIATION EFFECTS ON POLYMERS. K. Shinohara (Scientific Research Inst., Ltd., Tokyo), A. Amemiya (Tokyo Univ.), M. Matsumoto (Kurashiki Rayon Co., Ltd., Okayama, Japan), Y. Shinohara (Toyo Rayon Co., Ltd., Ishiyama, Shiga, Japan), and S. Ohnishi (Textile Research Inst. of Japanese Government, Yokohama). 18p.

Results are summarized from detailed studies made on the effects of radiation on polyvinyl alcohol in the solid state, in aqueous solutions, and in water-swollen states. Results are reported on attempts to improve the qualities of several synthetic fibers, nylon, polyethylene, polyvinyl alcohol, and others, by graft-copolymerization. (W.D.M.)

7053 A/CONF.15/P/1476
THE IRRADIATION OF ION EXCHANGERS IN JEEP. K. A. Nater (Joint Establishment for Nuclear Energy Research, Kjeller, Norway). 20p.

Several organic and inorganic ion exchanger materials were irradiated in JEEP. Radiation effects are described and dependence on dose rate and quality of the radiation is discussed. By comparing the action of different kinds of ionizing radiation, possible reaction mechanisms are discussed. (auth)

7054 A/CONF.15/P/1712
STATISTICAL THEORY OF SOLID BODY LATTICE DISTURBANCES AFTER BOMBARDMENT BY FAST NEUTRONS. Lenard Pál (Hungarian Academy of Sciences, Budapest). 14p.

The determination of the average number of displaced atoms produced by high-energy neutron radiation has been dealt with by Snyder and Neufeld. The fluctuations in the number of displaced atoms, however, have not been evaluated. In order to obtain an estimation of the reproducibility of the measurements on the specimens irradiated by neutrons under identical experimental conditions, it is of interest to determine the fluctuations in the number of displaced atoms. Using some simplifying assumptions, a general method was outlined for the solution of this problem. (auth)

7055 A/CONF.15/P/2052
IZMENENIE MEKHANICHESKIKH SVOISTV KONSTRUKTSIONNYKH METALLICHESKIKH MATERIALOV POD VOZDEISTVIEM NEITRONNOGO OBLUCHENIYA. (Change in Mechanical Properties of Structural Materials Under Neutron Irradiation.) N. F. Pravdyukh, S. T. Konobeevskii, et al. (U.S.S.R.). 30p.

The effects of pile irradiation on mechanical properties of structural metallic materials and on the internal friction of some metals are presented. Effects of irradiation temperature on tensile properties of austenitic stainless, carbon, and chromium steels, zirconium and some of its alloys, and nickel are presented. Effects of neutron flux at a constant temperature on tensile and impact properties of a number of structural steels are discussed. Irradiation hardening is shown to decrease with raising the irradiation temperature. Irradiation in a flux of 10^{20} n/cm^2 causes a considerable strength increase of all the materials investigated. Austenitic stainless steels maintain a rather good plasticity while the plasticity of carbon and chromium ferrito-perlite steels is strongly reduced. The recovery of the properties in the materials irradiated was investigated. The experiments to define the critical stress value at which a sharp increase of internal friction is observed in some metals before and after irradiation are described. The influence of plastic deformation and annealing on internal friction was investigated along with the study of the irradiation effects. The critical stress value for monocrystalline and polycrystalline zinc was measured. The experiments carried out with zinc suggest that the critical stress value can be related with the beginning of the dislocation movement. The increase of the critical stress value in irradiated metals should mean that dislocations are pinned due to the interaction with point imperfections. (auth)

7056 A/CONF.15/P/2085
O DEISTVII IONIZIRUYUSHCHIKH IZLUCHENII NA KAUCHUKI I REZINY. (The Effect of Ionising Radiations on Crude and Vulcanized Rubbers). A. S. Kuz'minskii (Kuzminsky), T. S. Nikitina, E. V. Zhuravskaya, L. A. Oksentevich (Oksentievich), L. L. Sunitsa, and N. I. Vitushkin (U.S.S.R.) 21p.

The structural transformations in rubbers resulting from exposure to x and gamma radiations were studied. The radiation vulcanization process is accompanied by a considerable decrease in the number of double bonds. The effect played by the principal components of a rubber mixture were determined. Radiation-cured carbon–rubber systems are characterized by good physical and mechanical properties and strong chemical bonding. The design of a Co^{60} gamma source constructed for work in this field is discussed. (J.S.R.)

7057 A/CONF.15/P/2191
VLIYANIE STRUKTURY I SVOISTV URANA NA EGO POVEDENIE POD OBLUCHENIEM. (Effect of Structure and Properties of Uranium on its Behavior under Irradiation). A. S. Zaimovskii, G. Ya. Sergeev, et al. (U.S.S.R.). 26p.

The results of investigations into the changes in uranium shape dimensions, and surface wrinkling under neutron irradiation are presented. Data are presented on the irradiation growth of texture of uranium. It has been shown that the length and diameter changes of textured uranium are a function of burnup and the initial grain size. It has been found that coarse-grained uranium with disoriented structure exhibits a wrinkling which in this metal leads to a substantial increase in the diameter of the specimens during irradiation. Heat treatment results in grain refinement and in a reduced wrinkling effect. Influence of impurity content and thermal treatment conditions on the grain size was studied. The study of uranium properties under irradiation is one of the major problems in investigating its radiation stability. (auth)

7058 A/CONF.15/P/2192
O NEKOTORYKH FIZIKO-KHIMICHESKIKH PROTSESSAKH, PROTEKAYUSHCHIKH V DELYASHCHIKHSYA MATERIALAKH POD DEISTVIEM OBLUCHENIYA. (On some Physico-Chemical Processes Occurring in Fissionable Materials under the Influence of Irradiation.) S. T. Konobeevskii, K. P. Dubrovin, et al. (U.S.S.R.). 47p.

A survey is presented of investigations on the effect of neutron irradiation on the structural transformation

in a U–Mo alloy and on the stress relaxation in α and γ uranium effected by irradiation, as well as by thermal cycling. A brief outline is given of the theoretical conceptions regarding the diffusion induced by thermal spikes in a fissionable material, and experimental data are presented on the electrical resistance of U–Mo alloys. It has been established that the irradiation of a homogeneous specimen causes rapid growth of electrical resistance which afterwards remains invariable for a long time. The time of saturation is compared with the time required for the entire volume of the metal to pass through the state of thermal spike. (auth)

RADIOACTIVE WASTE

7059 A/CONF.15/P/195

THE DISPOSAL OF FISSION PRODUCTS IN GLASS. L. C. Watson, R. W. Durham, W. E. Erlebach, and H. K. Rae (Atomic Energy of Canada Ltd., Chalk River, Ont.). 20p.

The disposal of fission products as components of a durable glass offers great promise as a method by which acceptable containment may be achieved at reasonable cost. The glass which has been studied most thoroughly at Chalk River is based on the glass-forming rock, nepheline syenite, suitably fluxed with lime. The rate of release of fission products from this glass to water is very low. For a typical glass containing 85 wt. % nepheline syenite and 15% lime, the measured rate of release of cesium-137 is equivalent to dissolution of about 10^{-7} grams of glass per square centimeter per day. The method of converting waste solution to glass involves a simple mixing of the dry, glass-forming materials with the solution of fission products in concentrated nitric acid; this solution may also contain dissolved sheathing materials. The components react to form a gel which can be dried and denitrated without giving rise to severe entrainment or dust. The mixture is melted at 1350°C and when cooled forms a glass. An extensive preliminary appraisal of methods of storing glass containing fission products was made, and it appears that storage can be accomplished at a cost under 0.01 mills per kwh. If the very low leaching rates achieved in the glass are not acceptable for the burial of megacuries of fission products in contact with ground water, dry storage can be provided. Several methods have been considered for the dissipation of heat generated in the glass by fission-product decay. (auth)

7060 A/CONF.15/P/297

THE DISPOSAL OF RADIOACTIVE LIQUID WASTES INTO COASTAL WATERS. H. J. Dunster (United Kingdom Atomic Energy Authority, Sellafield, Cumb., Eng.). 21p.

The data obtained during five years of experimental discharges of dilute liquid waste from Windscale Works, Sellafield, Cumberland, into the Irish Sea are reviewed. The results include measurements of the resulting radioactivity of fish, seaweed, sea bed, and shore sand, and where these are significantly different from natural levels of radioactivity, they are related to the amounts of radioactivity discharged. Maximum permissible levels of radioactivity in the relevant materials have been derived from the recommendations of the International Commission on Radiological Protection, and these have been used in conjunction with the monitoring results to estimate the maximum permissible rates of discharge from Windscale works. The discharge rates to date have ranged up to about 50,000 curies per year and the results reported show that this figure could safely be increased to several hundred thousand curies per year. Specific limitations are needed on the discharge rates of ruthenium 106, which is strongly adsorbed into surfaces, and of strontium 90 and alpha emitters, which tend to concentrate in human bone. The problems of relating these results from Windscale to discharges from other sites are discussed, and results are included for some small scale experimental discharges of radioactivity from Dounreay, Caithness, Scotland. (auth)

7061 A/CONF.15/P/308

DEVELOPMENT OF A SELF-CONTAINED SCHEME FOR LOW-ACTIVITY WASTES. R. H. Burns and E. Glueckauf (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 30p.

The main advantages of a self-contained scheme for the treatment of radioactive wastes are the avoidance of public opposition to discharges, the avoidance of the need for negotiation, as for example where two or more countries are involved, and water economy. Further, in certain locations it may not be possible to discharge wastes to the environments. The proposed scheme separates the wastes into re-usable water and liquid or solid concentrates. Preferably any solids formed should be of an unleachable nature. The first stage of the treatment consists of a calcium and iron phosphate precipitation followed, if necessary, by a sulfide treatment. Some chemical engineering aspects of the precipitation processes are described and a comparison made between various types of clarifiers. The treatment of the chemical sludges formed is of great importance and the freeze drying process, in use at A.E.R.E., Harwell, is described. The chemically treated effluent after clarification is passed through columns of natural vermiculite to remove any remaining strontium and cesium. Experience with this natural ion exchange material is given and the chemistry of exchange outlined. The advantages of incorporating an electro-deionization process in the treatment are outlined and the performance of such a process is compared with conventional mixed-bed exchange columns. The experience gained with laboratory and pilot plant electro-deionization units is described. Considerable experimental work has been carried out at A.E.R.E., Harwell on the heat drying and fusion of concentrates to form unleachable ceramics. Results obtained to date are given and the future program described. Suggested layouts for self containment are set out and the possible use of these for the cooling pond water for nuclear power stations is discussed. Finally, costs for the whole process are estimated. (auth)

7062 A/CONF.15/P/309

THE RECOVERY OF RADIO KRYPTON FROM DISSOLVER WASTE GASES BY FRACTIONAL EXTRACTION IN SOLVENTS. R. W. McIlroy, E. Glueckauf, H. J. de Nordwall, and F. C. W. Pummery (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 23p.

The use of solvents for scrubbing out soluble gases from mixtures is well known, but the separation of mixtures of relatively insoluble gases has not been studied very closely. A special case occurs, however, when small quantities of valuable gases occur in a mixture of less soluble gases. The mixture nitrogen, oxygen,

argon, krypton, xenon, and nitrous oxide which constitutes dissolver waste gas is a pertinent example. The last three have an abundance of 1% or less, and the required products are krypton (stable and radioactive) and xenon (stable). The solubilities of nitrogen, oxygen, and argon in carbon tetrachloride are <0.35 v/v and those of krypton, xenon, and nitrous oxide are >1 v/v. A plant designed to separate the first three from the last three components is described. In principle the system is similar to any two phase extraction system, but differs from the normal gas/liquid column in having a low gas flow and continuous liquid phase, and from a normal solvent extraction column in having bottom reflux. With low gas flows, back diffusion in a continuous gas phase would be very disadvantageous, consequently a continuous liquid phase was used. In this case steady operation with low gas flows requires considerable care and control. The feed concentration of the required product gases is low, and the effective separation factors are comparatively low. This requires an efficient reflux system at the foot, and the reflux ratio must be high. Equations were derived for the behavior of each component on the assumption that each gas has the same plate height. The calculation is complicated by the fact that the flow rate (of gas in both phases) is not constant along the length of the column but increases towards the foot due to the accumulation there of the more soluble components. This also leads to maxima in the concentration gradients of all gases in the mixture except those of greatest and least solubility, an effect which can only occur to any large extent in mixtures of more than two components having widely different solubilities. (auth)

7063 A/CONF.15/P/1175
PROBLEME DU REJET DES RESIDUS RADIOACTIFS LIQUIDES AU C.E.A. TRAITEMENTS ABOUTISSANT A DES REJETS EN RIVIERE. (Disposal of the Radioactive Effluents at the "Commissariat a l'Energie Atomique." Treatment Leading to Evacuation into a River). Duhamel, Menoux, and Candillon (Commissariat a l'Energie Atomique, Paris). 13p.

The problem of the treatment of liquid radioactive wastes at the Commissariat a l'Energie Atomique is considered with the idea of ultimate disposal in rivers in a condition which satisfies protection standards. The types of wastes from Saclay, Fontenay-aux-Roses, Bouchet, and Marcoule are described. The optimum conditions in which the wastes should be in order to satisfy all precautions are discussed with an examination of dilution, evolution of activity in the rivers, choice of disposal site, and isotopic dilution of the waste radioelements. (J.S.R.)

7064 A/CONF.15/P/1176
ESSAIS D'INCORPORATION DE SOLUTIONS CONCENTREES DE PRODUITS DE FISSION DANS DES VERRES ET DES MICAS. (Experiments on the Incorporation of Concentrated Solutions of Fission Products in Glasses and Micas). R. Bonniaud, P. Cohen, and C. Sombret (Commissariat à l'Énergie Atomique, Paris). 9p.

The permanent storing of concentrated fission products in liquid form presents many difficulties. Therefore, the possibility of fixing these activities in solid form in glasses and micas was investigated. In the preliminary tests reported on, a synthetic waste solution with cesium radioisotopes was used. The incorporation in glasses was studied in various sodium and potassium silicoaluminates. The retention of fission products by synthetic micas was also examined. The results showed the retention of cesium is good. Tests on the leaching to the glasses and micas by sea water gave satisfactory results. (J.S.R.)

7065 A/CONF.15/P/1178
THE INDUSTRIAL PROBLEMS RAISED BY THE PROCESSING OF RADIOACTIVE LIQUIDS. SOME OF THE SPECIFIC SOLUTIONS APPLIED AT MARCOULE. C. Bernaud (Société Générale d'Exploitations Industrielles, Paris). 12p.

The main features of the Marcoule radioactive effluents are given, and it is concluded that even with the low mean specific activity discharge cannot be made to the Rhone without previous treatment. The detailed examination of the characteristics of the effluents, in particular their considerable inactive dissolved product content, the search for maximum elasticity in operation, and the small amount of time available to study and develop new processes on an industrial scale, led to the choice of a processing method using coprecipitation and chemical coagulation. Coagulation takes place in the presence of lime at a pH of about 11.5. (W.D.M.)

7066 A/CONF.15/P/1355
OCEANOGRAPHICAL RESEARCHES ON THE WASTE DISPOSAL OFF THE COAST OF TOKAI-MURA. (Marine Safety Agency, Japan; Japan Meteorological Agency; Meteorological Research Inst., Japan; Tokai Regional Fisheries Research Lab., Japan, and Ibaragi Prefectural Fisheries Exptl. Station, Japan) 16p.

In coöperation with the Japan Atomic Energy Research Institute the oceanographical survey was carried out off the coast of Tokai-Mura, Ibaragi Prefecture, in the fall of 1956 in connection with waste disposal at sea. As a result of the survey it was shown that the tidal current is strong and a counterclockwise small circulation exists in an area south off Tokai-Mura on the western side of the Kuroshio. When some substances are discharged into the sea off Tokai-Mura, they are likely to be drifted southwards along the coast and spread over the area of the circulation. Then they are transported by the Kuroshio further to the high sea The distribution of submarine sediments was investigated, and the β radioactivity of sediments was measured. No remarkable activity was found in the area (auth)

7067 A/CONF.15/P/1415
INVESTIGATION INTO THE COMPOSITION OF THE SOLIDS FOUND IN THE SMOKE RELEASED IN THE CALCIOTHERMIC PROCESS FOR THE MANUFACTURE OF URANIUM. A. Travesí, F. de la Cruz, and R. F. Cellini (Junta de Energía Nuclear, Madrid). 24p.

A study is made of the composition of the smoke produced when obtaining uranium by the calciothermic reduction of the tetrafluoride, from the chemical and radio-chemical standpoints. In order to study the anomalies observed among the experimental data based on chemical and radiochemical determinations, the U/Th^{234} ratios are determined in uranium tetrafluoride, metallicuranium, and the solids contained in the smokes, identifying the existence of the compounds which are out of balance by interpreting the relevant disintegration curves. (auth)

7068 A/CONF.15/P/1515
ELIMINATION OF TRACES OF RADIOACTIVE ELEMENTS FROM AQUEOUS SOLUTIONS. I. FORMATION

OF SILICA GEL IN SOLUTIONS CONTAINING TRACES OF RADIOELEMENTS AS A MEANS FOR THE ELIMINATION OF ACTIVITY IN RADIOACTIVE EFFLUENTS. M. Milone, G. Cetini, and F. Ricca (Univ. of Turin). II. THE USE OF BASIC SILICA GEL FOR THE ELIMINATION OF RADIOELEMENTS IN AQUEOUS SOLUTIONS. G. Cetini and F. Ricca (Univ. of Turin). 19p.

The efficiency of the formation of silica gel for the elimination of traces of Sr^{90} and Cs^{137} in the active waters is reviewed. A study is made of the effect of the pH during the formation of the gel and of the presence of various concentrations of Al ions. A report is submitted on the results of Sr^{90} and Cs^{137} adsorption. A study is made of the influence of the conditions of precipitation of the gel and of the activation temperature on the adsorbing capacity of the basic silica gel. (auth)

7069 A/CONF.15/P/1676
TREATMENT OF RADIOACTIVE EFFLUENTS AT THE MOL LABORATORIES. P. Dejonghe, L. Baetsle, and G. Mosselmans (Centre d'Etude de l'Energie Nucléaire, Brussels). 22p.

The cold effluents (sanitary waste and decontaminated radioactive water) are flocculated with sodium phosphate and pumped through a trickling filter. The average decontamination obtained is about 85% for alpha emitters and 75% for beta emitters. The cool effluents (activity $< 10^{-3}$ μc/ml) can be treated by several methods. Provisions have been made for two successive chemical flocculations eventually followed by an adsorption. The warm waste treatment (activity between 10^{-3} and 1 μc/ml) is still in the experimental stage. The following methods are used: evaporation for some chemically contaminated wastes, browncoal filtration for reactor effluents, and a combination of chemical treatment and browncoal adsorption in other cases. (auth)

7070 A/CONF.15/P/2024
DECONTAMINATION OF LOW SALINE AND LOW ACTIVE EFFLUENTS OF RADIOCHEMICAL INDUSTRIES. S. A. Voznesenskii(Voznesensky), G. A. Sereda, P. F. Dolgikh, and L. I. Baskov (U.S.S.R.) 11p.

The purification and concentration of isotopes in radioactive effluents to a minimum volume is a most pressing problem. The average chemical composition and radiochemical composition of the effluents investigated are given along with the allowable levels and decontamination factors. The flow sheet for decontamination is given. It features coagulation and ion exchange resin sorption. (W.D.M.)

7071 A/CONF.15/P/2025
PILOT PLANT FOR DECONTAMINATION OF LABORATORY LIQUID WASTES. K. A. Bolshakov, A. T. Avdonin, V. T. Borchev, F. V. Rauzen, et al. (U.S.S.R.). 22p.

The technology and equipment of a plant for decontamination of radioactive sewage from research institutions using radioactive isotopes are described. The technology is based on the coprecipitation of radioactive isotopes with hydroxide residues, following by ion exchange sorption. Any changes in the chemical and radiochemical composition of the sewage are taken in account. When treating sewage containing considerable amounts of organic substances, biological purification in air tanks precedes the conventional decontamination. The contamination is effective enough for a safe disposal of purified sewage into open water reservoirs. (auth)

7072 A/CONF.15/P/2058
CONCERNING THE POSSIBILITY OF DISPOSING OF RADIOACTIVE WASTE IN OCEAN TRENCHES. V. G. Bogorov and E. M. Kreps (U.S.S.R.). 16p.

The discharge of radioactive waste into deep ocean depressions is based on the assumption that the mass of water in depressions at great depth is devoid of vertical or horizontal circulation. It was proved on the basis of data obtained in the exploration of 12 deep ocean depressions, and particularly of the Tonga depression, that in every depression there is a circulation of water which, though slow, is measured by decades and not by hundreds of years. (auth)

7073 A/CONF.15/P/2207
A STUDY OF THE MIGRATION OF RADIOELEMENTS IN SOILS. V. I. Spitsyn, V. D. Balukova, A. F. Naumova, et al. (Academy of Sciences, U.S.S.R.). 25p.

The capacity of various soils to absorb long-lived products of U fission (Cs^{137}, Sr^{90}, Ce^{144}, Ru^{106}, Zr^{95}, Nb^{95}) has been studied. Alluvial sands, loamy soils, and clays were the main objects of investigation. The results of laboratory experiments have shown that the absorption of radioelements by soils depends to a great extent on the pH of a solution. The mixture of radioelements is absorbed more or less readily from alkaline salt solutions, while in acid medium the absorption sharply decreases. (W.L.H.)

REACTORS

General

7074 A/CONF.15/P/10
MEASUREMENTS OF REACTOR SPECTRA BY TIME-OF-FLIGHT AND INTEGRAL METHODS. C. G. Campbell, R. G. Freemantle, and M. J. Poole (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 52p.

A pulsed source method was developed to measure the neutron spectrum in a sub-critical section of reactor lattice. The neutron spectra are determined by time-of-flight in a beam of neutrons extracted from the lattice. The relation between the spectrum of neutrons in the beam and in the assembly is discussed, and experimental results are shown to demonstrate the presence of strong angular effects in a lattice. Results are quoted for spectra in homogeneous absorbing systems and in a series of ordinary-water/uranium lattices. The integral measurements, which have been made in moderator and fuel positions in a range of water and graphite moderated lattices, are of the relative fission rates and fission cadmium ratios of U^{233}, U^{235}, and Pu^{239} together with some capture cadmium ratios for boron. The data have been analyzed in terms of the simplest spectrum parameters likely to be adequate for a thermal reactor: a Maxwellian thermal density distribution with characteristic temperature, T; a dv/v^2 epithermal density distribution with a temperature dependent lower limit. Comparisons of the results obtained by the two techniques with each other and with theoretical treatments are made. The significance of discrepancies and the desirability of a more complex spectrum analysis for the integral measurements is discussed. (auth)

7075 A/CONF.15/P/14
THE USE OF THE PILE OSCILLATOR IN THERMAL REACTOR PROBLEMS. H. Rose, W. A. Cooper, and R. B. Tattersall (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 26p.

An experimental program was carried out at Harwell, using the pile oscillator facilities of Dimple and Gleep. Thermal and epithermal absorption effects were separated by integral measurements in several different neutron spectra. A large number of samples were studied, including typical canning and structural materials, the heavy nuclei Np^{237} and Pu^{240}, and many of the important fission product poisons. The fissile nuclei U^{235}, U^{233}, and Pu^{239} were compared, and relative η-values deduced for several spectrum conditions. The Gleep pile oscillator was also used to make measurements of the changes in cross section of nuclear fuels arising from intensive neutron irradiation. Data were obtained for a variety of NRX and Windscale irradiated samples including natural uranium, thorium, and aluminum alloys containing small amounts of pure fissile material. (auth)

7076 A/CONF.15/P/16
ALBEDO METHODS. R. T. Ackroyd and J. D. McCullen (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). 29p.

A heuristic method is presented for calculating critical sizes of small cores. The theory is simple, and the method in its variational form demands no more than the solution of a simple quadratic equation for the determination of critical size. (W.D.M.)

7077 A/CONF.15/P/17
USE OF ANALOGUE WAX MODEL METHODS FOR REACTOR CALCULATIONS. I. A. Mossop and J. McGhee (United Kingdom Atomic Energy Authority, Sellafield, Cumb., Eng.). 20p.

It has been shown that an analogy exists between the temperature distribution in a cooling solid and the calculated one-group neutron flux distribution in a reactor. Use has been made of this analogy in solving various reactor problems, particularly where the geometry of control rods makes calculation difficult. A few examples of analog technique application are given, but it has been found impossible to extend the analog to two-group analyses. The treatment of problems involving reflectors can not be handled by the analog. (W.D.M.)

7078 A/CONF.15/P/18
THE CALCULATION OF THERMAL NEUTRON SPECTRA. P. Schofield and A. Hassitt (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 18p.

Results are reported of calculations of thermal neutron spectra, with particular reference to graphite moderated systems. Cross sections for inelastic scattering of neutrons by polycrystalline graphite were computed in the incoherent approximation, using a simplified phonon spectrum for the crystal lattice. At high temperatures and high neutron energies, multiphonon scattering is important and has been taken into account approximately. These cross sections are used first to calculate the thermal neutron spectrum in an infinite homogeneous capturing medium. The neutron balance equation is solved by dividing the energy range into thirty groups, and solving the resulting set of linear equations by in iterative procedure. The results are compared with those obtained on the assumption that the moderator is a monatomic gas. The infinite medium solutions are taken as a starting point for the calculation of spectra in inhomogeneous systems. Multigroup diffusion theory is used to calculate the neutron spectrum over two adjacent half-spaces at different temperatures. The variation of the thermal spectrum over a simple lattice is calculated. The relative reaction rates of various materials in neutron fluxes with the calculated energy spectra are computed, and compared, where possible, with experimental results. (auth)

7079 A/CONF.15/P/19
A CALCULATION OF RESONANCE ESCAPE PROBABILITY BY MONTE CARLO METHODS. K. W. Morton (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 7p.

A Monte Carlo program written for the IBM 704 to calculate the resonance escape probability (p) is described, and the results of several calculations are given. The program was designed for studying the temperature variation of p in the Calder Hall lattice consisting of a square array of natural uranium rods lying at the centers of cylindrical gas channels through a graphite moderator. In order to study the temperature effect it was found necessary to cover resonances up to 5 kev. The reduced neutron widths for these were sampled from the Porter–Thomas distribution, the spacing and γ-widths being assumed constant and the same as for the lower resonances. The spatial distribution and the energy distribution of the absorptions are also obtained from the calculations. The former is obtained less accurately than the rest of the results, but is possible to get from it some idea of whether the surface or the volume temperature of the fuel rods is most important in determining the temperature coefficient. One or two devices incorporated in the program to increase the efficiency of the Monte Carlo method are described and their merits discussed. (auth)

7080 A/CONF.15/P/22
RESEARCH REACTOR UTILISATION. K. Q. Bagley (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.), and F. W. Fenning and R. F. Jackson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 6p.

Uses of research reactors are divided into groups according to the neutron energy spectrum required and the physical size of the equipment necessary to insure correct environment of the test specimens. The spectrum requirement is discussed in relation to the phenomena to be studied and the methods of monitoring which are available. In addition, the method of calculating the total heat output and the gamma contribution to it is described, along with descriptions of operating procedures, sample examination, and laboratory physical requirements. (J.R.D.)

7081 A/CONF.15/P/26
THE ACTINIDE OXIDES. L. E. J. Roberts, M. H. Rand, L. E. Russell, and A. J. Walter (Atomic Energy Research Establishment, Harwell, Berks, Eng.) and A. G. Adwick (United Kingdom Atomic Energy Authority, [Risley, Lancs, Eng.]). 16p.

Some chemical properties of the actinide oxides and of solid solutions of these oxides with each other and with other oxides are reviewed. The subjects chosen are relevant to the use of UO_2 and PuO_2 as reactor fuels, either as ceramics or in dispersed systems such as cermets and slurries. Equilibrium pressures of oxygen over the UO_2–U_4O_9–U_3O_8 composition range were directly determined at high temperatures. These results are used to calculate the oxygen pressures below which the cubic UO_2–U_4O_9 phases are stable at various temperatures. The rate of oxidation within this composition range can be approximately calculated from diffusion coefficients for interstitial oxygen determined

at low temperatures. The process of phase division into the two cubic phases, UO_2 and U_4O_9, that occurs on temperature cycling is accompanied by particle division. The cubic UO_2 structure can be stabilized at higher oxygen pressures by making solid solutions with other 4-valent oxides such as ThO_2 and ZrO_2; excess oxygen can be incorporated interstitially in all such structures. Equilibria between UO_2–ThO_2 solid solutions and oxygen have been measured over a wide range of pressure, temperature, and composition. The degree of oxidation under given conditions diminishes as the uranium content decreases, mainly because the heat of solution of oxygen in the lattice decreases. Uranium dioxide forms a number of anomalous solid solutions with trivalent and divalent oxides and the stability of the fluorite structure is such that extensive solid solutions can be formed between UO_2 and oxides such as MgO and Al_2O_3, which do not dissolve appreciably in stoichiometric UO_2, if sufficient oxygen is present to complete the MO_2 structure. The diffusion of oxygen through such structures containing U and anion vacancies seems anomalously rapid as compared to oxygen diffusion through ThO_2 containing anion vacancies. From such studies, certain predictions can be made about the behavior of solid solutions containing PuO_2 and NpO_2, which cannot be easily oxidized in the pure state. Some forms of PuO_2 can be oxidized as far as $PuO_{2.1}$ but NpO_2 has not been oxidized beyond $NpO_{2.01}$ despite the stability of Np_2O_5 at low temperatures. UO_2 and ThO_2 form solid solutions with NpO_2 and PuO_2. Preliminary results on the preparation, stability, and oxidation of these solid solutions are recorded, together with some data on anomalous solid solutions containing the transuranic elements. (auth)

7082 A/CONF.15/P/39

EXPERIMENTAL WORK WITH ZERO ENERGY FAST REACTORS. R. D. Smith and J. E. Sanders (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 83p.

In the small plutonium fuelled reactor, Zephyr, the original natural uranium reflector was replaced by graphite as a first stage in the study of mixed thermal-fast systems. Zeus uses enriched uranium fuel with a natural uranium reflector, in order to simulate as closely as possible the nuclear characteristics of the Dounreay fast breeder reactor. Fission and activation rate distributions, kinetic studies, and perturbation measurements were made for both reactors and the results for several different core configurations in Zeus are compared. Measurements of the mean neutron life-time were obtained by both static and kinetic techniques. The temperature coefficient due to the Doppler effect in Zeus was estimated by measuring the perturbation effect caused by heating a U^{235} sample at the center of the core. The results of some of these experiments are compared with theoretical predictions using one-group and multi-group theories. (auth)

7083 A/CONF.15/P/46

SOME CHEMICAL PROBLEMS OF HOMOGENEOUS AQUEOUS REACTORS. J. K. Dawson, B. Cox, R. Murdoch, and R. G. Sowden (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 29p.

The basic chemical and engineering aspects of aqueous homogeneous reactors were investigated. The primary effort was devoted to the two-zone uranyl sulfate solution/thoria slurry system. Corrosion associated with the neutron window of the two-zone system is discussed, together with various methods of decreasing the rate of attack. The feasibility of the use of uranyl nitrate as the fissile solution and thorium nitrate as a fertile solution was examined. Thorium nitrate may find applications in core solutions, if the processing rate is sufficient to maintain a low uranium content. The rheology of aqueous slurries of thoria is described, and measurements in a pipe-line viscometer are compared with the result of pumping the same slurry in a loop system. Plutonium dioxide suspensions were examined for use in the fuel circuit of a burner reactor. The physical properties of the oxide prepared by various methods were measured, and electrophoretic properties were compared with those of thoria. (J.R.D.)

7084 A/CONF.15/P/48

THE POLYZONAL SPIRAL FUEL ELEMENT. H. L. Ritz (Nuclear Power Plant Co., Ltd., Knutsford, Ches, Eng.). 37p.

The application of the polyzonal spiral fuel element and the main benefit derived from it are discussed, and the aerodynamic and thermodynamic principle on which its design is based is described. The special conditions prevailing in a gas-cooled reactor fuelled with natural uranium are discussed, and the fundamental requirements of an efficient fuel element configuration are evolved. These can be satisfied by methods applicable in modern aircraft design. The first approach, its progressive perfection, and the final configuration are explained, and the influence on the flow pattern is demonstrated. Different experimental techniques were applied to establish the performance of the surfaces evolved, and their relative advantages and limitations are outlined. Aerodynamic and thermodynamic test results obtained on a prototype fuel element under various test conditions are discussed, and the characteristic test conditions are established. To establish the influence of any one of the variables involved, sets of test results are shown which were obtained with a series of 53 systematically varied surface configurations. The results are analyzed and compared with the performance of standard heat transfer surfaces. Methods of manufacturing the spirally-finned surfaces and their relative merits are discussed. The flow pattern characterizing this element can be maintained on fuel elements with primary surfaces only. The forms of such fuel elements, which may be applicable in future reactor designs, can be derived from the form described before by geometrical transformation. The characteristic features of this element can be maintained, and the local heat transfer coefficients can be improved. (auth)

7085 A/CONF.15/P/56

NEUTRON FLUX INSTRUMENTATION FOR RESEARCH AND POWER REACTORS: A REVIEW OF PRESENT METHODS AND NEW DEVELOPMENTS. W. Abson, R. J. Cox, and A. L. Gray (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 30p.

The range of applications and limitations of existing types of equipment used in the U.K.A.E.A. reactors is considered, and the extent is indicated to which new developments in the design of detectors and of d-c ionization chambers and pulse-counting equipment may improve the range of measurement and reliability of neutron flux monitoring systems. (W.D.M.)

7086 A/CONF.15/P/57

THE DETECTION OF BURST FUEL ELEMENTS IN NUCLEAR REACTORS. K. W. Cunningham, G. V. Hough, and D. Aliaga-Kelly (Plessey Nucleonics Ltd., Northampton, Eng.). 25p.

A general survey is made of the current practice of burst fuel detection systems and the problems involved. A description is given of the Calder Hall equipment, followed by the improvements which are being introduced for the first stage C.E.A. nuclear power stations. The corresponding requirements for water cooled reactors are considered and some details given of apparatus which has operated successfully on a research reactor. An outline is given of some of the problems which confront future designs and some possible ways in which solutions may be obtained. (auth)

7087 A/CONF.15/P/58
EXPERIENCE IN THE DESIGN OF IRRADIATION EXPERIMENTS. H. Cartwright and B. E. Eltham (Atomic Energy Research Establishment, Harwell, Berks, Eng.) and R. F. Jackson (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). 15p.

The design, testing, and installation of irradiation experiments for fissile and non-fissile materials are discussed. (A.C.)

7088 A/CONF.15/P/84
SOME DESIGN CRITERIA FOR HYDROGEN–METAL REACTOR SHIELDS. C. Cooper and J. D. Jones (Atomic Energy Research Establishment, Harwell, Berks, Eng.), and C. C. Horton (Rolls-Royce Ltd., Derby, Eng.). 22p.

The detailed distributions of thermal flux were investigated for a series of multilayered systems of iron and water, and the experimental data were interpreted on the basis of a three-group model. This model attempts to describe the three basic features of neutron behavior in shields, viz. the flight of virtually uncollided neutrons (described in the model by "removal" theory), the slowing down of neutrons subsequent to scattering out of the uncollided group, and the diffusion of neutrons at thermal energies. For an adequate interpretation of the data on the basis of this model, however, it was necessary to obtain some of the three-group parameters empirically for iron and water. The three-group model described provides a prediction of the thermal flux (to an accuracy of better than 20%) and the epithermal flux. Ease of application to complex multilayered systems is achieved at the expense of using the empirical parameters. (auth)

7089 A/CONF.15/P/107
DYNAMIQUE DES REACTEURS A BASSE PUISSANCE. (Kinetics of Low Power Reactors.) Henri B. Smets (Belgium). 25p.

An analytical study was made of the transient behavior of low-power reactors. It is shown how the effect of six delayed neutron groups can be analyzed by means of an approximation which makes use of only one or two equivalent groups of delayed neutrons. Reactor kinetics is reviewed under the assumption that there is only one equivalent group of delayed neutrons. The transient response is determined for a pulsed variation, a linear variation, an exponential variation, and a 1/t variation in the reactivity. An indication is given of a method of extending the results obtained to the case of six groups of delayed neutrons. The case of a reactor in which the reactivity undergoes periodic oscillations is considered. It is shown that the neutron flux increases exponentially when the reactivity is a quasi-harmonic function of zero mean. (J.S.R.)

7090 A/CONF.15/P/124
REFROIDISSEMENT PAR CONVECTION NATURELLE DE COMBUSTIBLE NUCLEAIRE IRRADIE. (Natural Convection Cooling of Various Types of Nuclear Fuel Elements Following Irradiation.) A. de Stordeur, J. M. Morelle, and J. P. Van Dievoet (Société Belge pour l'Industrie Nucléaire, Brussels). 77p.

A theoretical analysis of the natural convection cooling of nuclear fuel elements is presented. It is assumed that the cooling of the irradiated elements is done in a medium of constant temperature. The characteristics of the cooling depend only on the generation of heat in the element, its geometry, the nature of the coolant, and its constant temperature. Cooling in a gaseous or liquid medium with and without boiling is considered. The equations which describe the relationships between the coolant and the fuel are presented graphically. For cooling in gaseous media, consideration is given radiative transfer. The available experimental data are analyzed and compared with the theoretical results obtained. (J.S.R.)

7091 A/CONF.15/P/151
CALCULATION OF LATTICE PARAMETERS FOR URANIUM ROD CLUSTERS IN HEAVY WATER AND CORRELATION WITH EXPERIMENTS. B. Pershagen, G. Andersson, and I. Carlvik (AB Atomenergi, Stockholm). 24p.

Methods have been developed for predicting the buckling of cold clean lattices of uranium metal or uranium oxide (UO_2) rod clusters in heavy water. The methods involve refinements and modifications of the standard two-group recipe and have been correlated with exponential and critical experiments. In principle, the lattice parameters ϵ, p, f, L^2, and τ are calculated, and η is determined from measurements of the buckling. (auth)

7092 A/CONF.15/P/152
CALCULATIONS OF THE INFLUENCE OF A LARGE NUMBER OF CONTROL RODS ON THE REACTIVITY OF A THERMAL REACTOR. I. Carlvik, H. McCririck (AB Atomenergi, Stockholm), and S. Brimberg (ASEA, Västerås, Sweden). 22p.

A generalization of Garabedian's treatment and N full length control rods in arbitrary positions are dealt with. Up to a certain point the formalism has been treated in general terms. Before setting up the critical equation, a zero-order approximation is introduced which neglects the angular dependence of both singular and nonsingular terms, thus reducing the number of unknown constants. The solution of the equation then obtained gives the radial buckling which represents the total thermal neutron leakage from the active reactor core in the radial direction, i.e., the neutrons streaming out from the reflector and the neutron absorption in the black control rods. Reduced formulas are given in the simple cases of up to four concentric rings, each ring consisting of up to eight rods. Results from the numerical evaluation of such ring cases are presented. The case of a large number of control rods arranged in a regular lattice which occupies a coaxial cylindrical region of the reactor is treated. The control rod region is divided into cells with one control rod in each of them, and the region is homogenized in a manner analogous to that used for calculating the thermal utilization. This gives a new multiplication constant and a new diffusion length in the control rod region. For a certain natural uranium heavy water reactor, the calculated control rod effect is given in a number of cases for different rod radii, rod lengths, and numbers of rods. In some cases the corresponding value for the equivalent extrapolated

reactor is given for comparison. In one case, with full length control rods, a comparison is made between the results from the generalized Nordheim-Scalettar and Garabedian method and from the homogenization method. (auth)

7093 A/CONF.15/P/157
HYDRAULIC STABILITY IN REACTOR FUEL ELEMENTS. L. Brathäll, J. Flinta, et al. (AB Atomenergi, Stockholm). 10p.

Experiments to confirm the calculations for hydraulic stability of R-3 fuel elements with a long electrically heated tube which simulates a channel in a fuel element are described. The increase in the multiplication factors given in the literature appears to be due to bubble formation on that part of the heated tube surface already at nucleate boiling. (W.D.M.)

7094 A/CONF.15/P/158
A PNEUMATIC SYSTEM FOR IRRADIATION IN A NUCLEAR REACTOR. E. Haeffner, E. Jonsson, et al. (AB Atomenergi, Stockholm). 12p.

The system used for irradiations in the Swedish reactor R1 is described. The target materials are hermetically enclosed in aluminum cans. The irradiation arrangement consists of three movable cylinders, each of which is put in a horizontal channel through the reactor and operated by a pole sticking out through the reactor wall. The cylinders each contain 20 bores in which the cans fit. A loading tube leads to the channel from above and an unloading one from below. By pulling the pole it is possible to place any bore straight in front of the loading tube and a sample can be blown in by compressed air. T To remove the can, the cylinder is moved and turned 180° which causes the can to drop into the unloading tube. Samples can be inserted or removed while the reactor is operating at full power. This means that the irradiation time can be chosen arbitrarily and that the arrangement has a great capacity for short time irradiations. Radioactive samples are not taken out into the reactor hall but are sucked by vacuum from the reactor to a bank where they are stored behind a radiation shield. Holders are fastened to an endless chain so that the samples can be taken in and out independently. From the bank the samples are transported to a hot laboratory or to a handling cupboard where they are transferred to shipping containers. The samples may also be taken directly from the reactor to the laboratory or the cupboard. (auth)

7095 A/CONF.15/P/161
MEASUREMENTS OF THE "GEOMETRIC BUCKLING" USING THE PULSED NEUTRON SOURCE TECHNIQUE. N. G. Sjöstrand (AB Atomenergi, Stockholm). 8p.

Two studies on geometric buckling using the pulsed neutron source technique are reported. One study is on reactors of special shapes and the other on the effect of control rods. (W.D.M.)

7096 A/CONF.15/P/162
MEASUREMENTS ON DISADVANTAGE FACTORS IN A SMALL MOCK-UP. C. E. Wikdahl and F. Åkerhielm (AB Atomenergi, Stockholm). 9p.

The thermal neutron flux distribution in a lattice cell was measured using a small mock-up. Seven fuel elements were arranged in a hexagonal lattice in an aluminum box, which could be placed in the thermal column of the Swedish reactor R1. Copper wires running through both fuel and moderator were used as detectors. After irradiation the wires were rolled to tapes and the activity was measured along the tapes. The advantages of the tapes compared with the wires are reduced self-absorption and increased resolution. The flux distribution in the central lattice cell was measured along two diameters at an angle of 30°. Corrections with respect to the macroscopic flux and epithermal neutrons were applied. A "shadowing effect" was observed. Experiments were made with clusters of 7 uranium rods and 19 and 27 uranium oxide rods, and single uranium rods. (auth)

7097 A/CONF.15/P/202
EFFECTIVE CROSS SECTIONS AND CADMIUM RATIOS FOR THE NEUTRON SPECTRA OF THERMAL REACTORS. C. H. Westcott, W. H. Walker, and T. K. Alexander (Atomic Energy of Canada Ltd., Chalk River, Ont.). 16p. (AECL-612.) $0.25(AECL).

A convention for stating effective cross sections is described. It is based on equating the reaction rate per atom, R, to the product of the effective cross section $\hat{\sigma}$ and nv_0, where n is the total neutron density and v_0 is 2200 m/sec. On the assumption that the reactor spectrum is composed of a Maxwellian component characterized by a temperature T and a dE/E component cut off at a lower energy limit E_1, the effective cross section can be expressed as $\hat{\sigma} = R/nv_0 = \sigma_0 (g + rs)$, where σ_0 is the 2200 m/sec cross section, r is a measure of the fraction of the neutron density in the dE/E component, $g\sigma_0$ is the effective cross section in the Maxwellian component of the spectrum, and $s\sigma_0 = \sqrt{4T/\pi T_0} \int_{E_1}^{\infty} [\sigma(E) - g\sigma_0 v_0/v]\, dE/E$ (T_0 = 293.6°K). When the cross section varies inversely as the neutron velocity, g = 1 and s = 0; for other important cases g and s have been tabulated as a function of temperature. Cadmium-ratio measurements in a reactor neutron spectrum provide a method for determining the parameter $s(T_0)$ of materials which are important in reactor calculations. An experiment is described in which measurements of the cadmium ratios of gold and Pu^{240} were combined with the tabulated value of $s(T_0)$ for gold to give a value of 32.15 ± 0.50 for $s(T_0)$ of Pu^{240}. (auth)

7098 A/CONF.15/P/211
THE NRU REACTOR. Winnett Boyd (C. D. Howe Co. Ltd., Montreal) and F. W. Gilbert (Atomic Energy of Canada Ltd., Chalk River, Ont.) et al. 22p. (AECL-621). $0.25(AECL).

NRU is the high-power research reactor at Chalk River, designed for fundamental research, nuclear-engineering research, and isotope production. It is cooled and moderated with heavy water. The fuel is natural uranium metal bars clad with aluminum by an extrusion process. The total power is 200 Mw, the maximum thermal flux 3×10^{14} neutrons cm^{-2} sec^{-1}, the surplus reactivity at full power about 0.046. The fuel may be replaced while operating at full power. The reactor is designed to facilitate changing or repairing internal structure including the core vessel. The control system is automatic, bringing the reactor to the desired power at a controlled rate and holding it there. The ion chambers register the power over the whole operating range from full power down to complete shutdown. Both the control system and the protective shutoff system are designed to permit thorough testing without interrupting or otherwise disturbing operation. Particular attention was given to provision for irradiation of experimental fuel assemblies and in-pile experimental loops. The reactor is of ample size for this purpose. Large heavily shielded rooms near the reactor

will accommodate the experimental loop equipment. Three permanent loops, designed for use over a range of conditions, will be installed. Two of these are being designed for liquid cooling at pressures up to 133 atmospheres and maximum power of 1500 kw each. The third is for gas cooling at pressures up to 67 atmospheres and 1000 kw maximum power. There are seven horizontal beam holes of 30 cm diameter, twelve of 15 cm diameter, and four of elliptical cross section 11 cm × 8 cm, which penetrate to positions near the center of the core. Care was taken in the design of the graphite thermal column to obtain a high cadmium ratio as well as a high neutron flux. Air, steam, propane, water, drain, and electric services are provided at each experimental hole position. (auth)

7099 A/CONF.15/P/212
NATURAL-URANIUM HEAVY-WATER LATTICES, EXPERIMENT AND THEORY. D. W. Hone, E. Critoph, M. F. Duret, R. E. Green, A. Okazaki, R. M. Pearce, and L. Pease (Atomic Energy of Canada Ltd., Chalk River, Ont.). 34p.

Lattice experiments and analyses carried out as part of the design studies of the NRX, NRU, and NPD reactors are described. The results of these experiments, measures of the laplacian of the lattices, are presented. The experiments were done in ZEEP. (W.D.M.)

7100 A/CONF.15/P/213
THE CONTROL OF CANADIAN NUCLEAR REACTORS. A. Pearson, E. Siddall, and P.R. Tunnicliffe (Atomic Energy of Canada Ltd., Chalk River, Ont.). 16p. (AECL-623). $0.25(AECL).

Some features of current Canadian practice in the design of control and safety equipment for high-flux reactors are described. (W.L.H.)

7101 A/CONF.15/P/231
SIMULATION OF THE DYNAMIC BEHAVIOUR OF THE SWISS D_2O REACTOR DIORIT. H. Albers (Reactor Ltd., Switzerland) and B. Walter (Landis & Gyr Ltd., Switzerland). 48p.

DIORIT is a D_2O-moderated, D_2O-cooled test reactor using 6 tons of natural uranium at a specific power of 2 to 4 Mw per ton. As the effluent from the individual cooling shrouds overflows into the bulk of the moderator a very efficient negative reactivity feedback is expected in the power range. The mechanism of this feedback is of major importance for the start up procedure, for the response to sudden changes in reactivity, and for general reactor control problems. The dynamic behavior of the reactor has been simulated with the aid of an analog computer of almost conventional design. Computations of the dynamic behavior of the reactor are described. Special attention is given to safety considerations. The maximum permissible rate of reactivity change is determined. The influence of fast changes of primary and secondary cooling rates is studied. Possible startup accidents and the time dependence of power after a fast shutdown are investigated. Transfer functions of the reactor are obtained. The performance of the automatic control system in case of different feedback circuits is studied. The results yield a sound basis for the layout of the control and safety circuits and the proper choice of operational conditions. (auth)

7102 A/CONF.15/P/232
DERIVATION OF AN INTEGRAL EQUATION AS AN ALTERNATIVE FUNDAMENT OF REACTOR KINETICS. P. Schmid (Reaktor A. G., Würenlingen, Switzerland). 34p.

Also issued separetly as RAG-5 and previously abstracted in NSA Vol. 13, as abstract No. 946.

7103 A/CONF.15/P/233
SUR L'INFLUENCE D'UNE FENTE ANNULAIRE SUR LA REACTIVITE D'UN REACTEUR CYLINDRIQUE A SYMETRIE AXIALE. (Influence on Reactivity of an Air Gap Between Two Concentric Regions of a Cylindrical Reactor.) J. Patry (Reaktor A. G., Würenlingen, Switzerland) and R. W. Meier (Sulzer Bros. Ltd., Winterthur, Switzerland and Reaktor A. G., Würenlingen, Switzerland). 19p.

In a cylindrical reactor, bare on the flat faces, two concentric regions are separated by an annular air gap. Its width is assumed to be small compared with the radius of the ring. The diffusion properties on both sides of the gap may be different, in particular the outer zone may be a reflector. The loss in reactivity due to this gap is caused by two effects: neutrons leaving the outer zone in a flight path nearly tangential to the annulus may miss the core and get back to the same region (decrease in albedo); and neutrons may lose importance due to streaming in axial direction of the finite cylinder. In order to study this latter effect, the air gap is replaced by equivalent neutron sinks, and a perturbation method is applied similar to the approach by Critoph and Pearce (J. Nuclear Energy 4, 445-59 (1957)) for cylindrical hollow channels in a reactor. A numerical example for the heavy water research reactor DIORIT is given. In this case the effect on reactivity of the air gap for cooling of the reflector is calculated. (auth)

7104 A/CONF.15/P/245
LES PROPRIETES PHYSIQUES DE QUELQUES ELEMENTS COMPOSES, DANS DES REACTEURS DU TYPE U–D_2O. (Physical Characteristics of some Composite Natural Uranium Fuel Elements in Heavy Water.) P. Lehmann, R. W. Meier, and J. P. Schneeberger (Sulzer Bros. Ltd., Winterthur, Switzerland). 21p.

Lattices of natural uranium and heavy water were investigated for two types of fuel elements—the rod cluster and tube cluster types. The geometric dimensions of uranium are determined by thermal considerations assuming a surface heat flux of 100 w/cm^2 and fixing the number of subelements per cluster. The specific power (w/g of fuel) is a parameter varied within reasonable limits. New methods for the calculation of the lattice parameters ϵ, p, and f were employed, including recently published American, Canadian, and French methods. Some further refinements for the resonance capture of interior surfaces of the composite elements were developed which are applicable to systems with a coolant material different from the moderator. Finally, the material buckling is obtained for the cold-clean as well as the hot-poisoned case. The methods of calculation are then applied for other subdivided elements very similar in geometric shape for which the material buckling is known from exponential or critical experiments. (auth)

7105 A/CONF.15/P/260
SOME OPERATION EXPERIENCE WITH THE SWISS POOL-TYPE REACTOR SAPHIR. F. Alder, A. Colomb, W. Hunzinger, T. Hürlimann, and H. Winkler (Reactor Ltd., Würenlingen, Switzerland). 41p.

An account is given of the major changes on the swimming pool reactor operated by the USAEC at the first Geneva Conference now operating at Würenlingen. The calibration of the control rods and the measurement of their release time are described. Several critical arrangements are shown. The flux distribution and power calibration are given. The temperature, power, and xenon effects are discussed. The influence of beam holes on reactivity is shown. The results are given for several methods of determining the pool water activity. The decay of N^{16} in the hold-up tank was measured. (W.D.M.)

7106 A/CONF.15/P/272
SOME METHODS OF CALCULATING NUCLEAR PARAMETERS FOR HETEROGENEOUS SYSTEMS. S. E. Barden, D. Blackburn, A. Z. Keller, and J. M. R. Watson (AEI-John Thompson Nuclear Energy Co., Ltd., Knutsford, Ches., Eng.). 30p.

Developments and applications of the Wigner-Seitz method and the individual sink and source method for calculating the relevant parameters of heterogeneous systems are discussed with particular reference to uranium-fueled, gas-cooled, graphite-moderated reactors. Methods suitable for general geometries of fuel and channel are developed. Numerical results are obtained for some rectangular channels using the Wigner-Sietz method and for the amount of reactivity taken up by an array of control rods by using the sink and source method. A common starting point for the generalization of both methods can be based on a single integro-differential equation which is formulated and discussed. (W.D.M.)

7107 A/CONF.15/P/306
THE ASSESSMENT AND TESTING OF FUEL ELEMENTS. H. K. Hardy and H. Lawton (United Kingdom Atomic Energy Authority, [Springfields, Lancs, Eng.]). 24p.

Recent U.K. Atomic Energy Authority experience in assessing the performance of fuel elements for power reactors is described, together with examples of the experimental work conducted out-of-pile. A theoretical appraisal was made of the factors which may limit the working life of the reactor under the design conditions or which may make large-scale manufacture of the fuel elements difficult or costly. The analysis pays attention to the sources and magnitudes of the strains likely to arise in the fuel elements. Irradiation effects on metallic uranium fuel include changes in macroscopic shape due to preferred orientation, volume swelling caused particularly by gaseous fission products, the development of surface irregularities associated with individual grains, and irradiation creep due to deformation while undergoing fission under applied loads. Strains may also be caused by stresses due to temperature gradients, by thermal creep under applied load and by thermal cycling. Strains in the can arise from the accommodation of the deformation of the fuel and are created by the forces due to the coolant flow. Experiments were conducted in-pile to establish the basic phenomena both at Windscale and A.E.R.E., Harwell. Creep rates were determined by tests of samples and by tests on the actual components, both separately and after assembly. The behavior of the fuel elements during a number of the postulated hypothetical reactor faults is of interest. The behavior of the Calder Hall reactors and fuel elements were examined and the implications taken into account. The experimental work includes the proving of the production techniques for the fuel elements. Nondestructive testing methods are used to establish the soundness of the materials of the final elements. The influence of the production methods on the performance of the fuel elements has been considered in the analysis and by experimental checks. (auth)

7108 A/CONF.15/P/313
THE MERLIN RESEARCH REACTOR. T. E. Allibone, D. R. Chick, K. Firth, B. Millar, I. Munro, and A. J. Salmon (Associated Electrical Industries, Ltd. Research Lab., Aldermaston, Berks, England).

The 5 Mw research reactor, built by private industry at Aldermaston, England, is described. The reactor will be used for both fundamental and applied research and training by industry, universities, and other research institutions. The reactor itself is described in detail with emphasis on the experimental facilities and the radiation fluxes available. The control system, considerations of safety, and methods of operation are described. The source of secondary cooling water, the water system, and the site effluent system are described. The site facilities, including those for the handling of active material, are noted, and estimates are made of the costs of the project as a guide to further possible investment in this type of research tool. (auth)

7109 A/CONF.15/P/324
EXTRACTION DE LA CHALEUR DES REACTEURS REFROIDIS AU GAZ. COMPARAISON DE DIFFERENTES FORMES DE GAINAGES. (Heat Removal from Gas Cooled Reactors. Comparison of Different Types of Claddings). P. Marien (Centre d'Étude de l'Énergie Nucléaire, Brussels). 33p.

The cooling of finned claddings by air was studied in an experimental channel outside the pile. The experimental arrangement is described with emphasis on the simulation of the heating of uranium and on the measurement of surface temperatures. The results obtained from coefficients of friction, Stanton numbers, and the quality indices are presented in a form which permits an easy comparison of all the results. Claddings with broken longitudinal fins appear to be the best for the cooling of gas-cooled reactors. (tr-auth)

7110 A/CONF.15/P/325
UNE METHODE DE REMPLACEMENT D'UNE REGION D'UN REACTEUR PAR UNE AUTRE DE GEOMETRIE PLUS SIMPLE. (A Method for Replacing a Region of a Reactor by an Other Region, Geometrically Simpler). H. Dopchie (Centre D'Étude de l'Énergie Nucléaire, Brussels). 14p.

In many problems, where the diffusion equations are used, it is useful to replace a region, of a reactor for instance by another geometrically simple (usually circular) region. This method is frequently applied in the calculations of a cell of an heterogeneous reactor, or of control rod efficiency. A way of evaluating the boundary conditions of the simplified region is presented, based on the equalization of averaged albedos. (auth)

7111 A/CONF.15/P/334
PROGRES RECENTS DE LA DETECTION DES RUPTURES DE GAINES DANS LES REACTEURS FRANCAIS, G1, EL2, G3, EL3. (Recent Progress in the Detection of Bursts in the Canning in French Reactors, G1, EL2, G3, EL3.) J. Goupil, M. Grenon, J. Raffailhac, and

A. Roguin (Commissariat à l'Énergie Atomique, Paris). 46p.

In heterogeneous reactors the fuel is protected from contact with the coolant by a coating. Any fissure or break in this canning must be detected so that excess reactivity can be avoided. The methods and apparatus used in the gas-cooled reactors G-1, G-3, and EL-2 and in the water-cooled reactor EL-3 are described. The method is based on the detection of fission gases. An instrument named the evolution meter is designed to make the measurement of the activity of the coolant gas in the channels by a zero method, and it is independent of the activity of the coolant itself and of the uranium contamination of the canning. In the EL-3 the detection system is based on measurements by G-M counters of the activity of the fission gases carried by diluted helium into the heavy water and then extracted by hydrocyclones. (J.S.R.)

7112 A/CONF.15/P/335

THE EL.3 REACTOR. J. Robert, J. Hainzelin, and V. Raievski (Commissariat a l'Énergie Atomique, Paris and Chantiers de l'Atlantique Penhoët-Loire, Paris). 89p.

The EL3 was started up in December 1957. The core, comprising 100 cells arranged according to a centered hexagonal lattice, is surrounded by a first reflector 0,40 m thick of heavy water, then by a second reflector of graphite. The primary cooling is ensured by a circuit of heavy water flowing at 1000 m^3/h, cooled by a circuit of light water flowing at 2000 m^3/h which loses its heat in an atmospheric coolant. The secondary cooling system is an open air circuit, whose first objective is to ensure the ventilation of the pile hall and which, on leaving the pile, is discharged to the atmosphere through a chimney after a thorough filtration. The control system comprises, in addition to the power measurement and pile operation installations, numerous thermodynamic measurement instruments and a device for detecting bursts in the canning, cell by cell. The pile EL3 possesses many experimental appliances placed in the pile core, heavy water reflector, graphite reflector, and in various locations for protection. Circuits of demineralized water, carbon dioxide, compressed air, and electricity supply these experimental appliances. Active materials are unloaded by means of tools specially studied for each type of canal. The neutron flux in the pile is limited by the heat flux at the surface of the fuel elements. The thickness of uranium is dependent on this, and tubes 22 to 29 mm in diameter were chosen. The calculation of critical dimensions is identical to that used for D_2O–natural uranium lattices. The effect of experimental holes necessitates a more elaborate theory, especially where the radial canals situated in the reflector are concerned. The critical mass rises from 285 kg for the cold pile to 650 kg for the hot pile, poisoned and loaded with the experimental appliances. These extreme values bring about a corresponding variation in the neutron flux distribution and in the efficiency of the control systems. In order to study this variation, starting-up experiments have been carried out on two cold piles, the ratio of whose volumes was two. The large-volume pile is obtained by removing in a regular fashion one uranium rod in three, thus forming a hexagonal non-centered lattice. (auth)

7113 A/CONF.15/P/336

NATURAL URANIUM–HEAVY WATER LATTICES. Y. Girard, J. C. Koechlin, J. Moreau, and R. Naudet (Commissariat à l'Énergie Atomique, Paris). 97p.

A group of Laplacian determinations were made, under critical running conditions in the heavy water-natural uranium pile "Aquilon" constructed for this purpose, using either complete lattices or samples of lattices employing a two-zone method. The experimental equipment and methods of measurement are briefly described. Measurements were made for square lattice cells, going in 20 mm intervals from 130 to 250 mm. Results are presented for various bars. Other effects were measured. (W.D.M.)

7114 A/CONF.15/P/475

EFFECTIVE BOUNDARY CONDITIONS FOR SLIGHTLY CURVED REACTOR SURFACES. M. Ribarič (J. Stefan Inst., Ljubljana, Yugoslavia). 10p.

An approximative expression is derived by one-group diffusion theory for the relation between the neutron flux and its normal derivative at the boundary of a slightly curved reflector. This relation forms the effective boundary condition for the core at the interface core-reflector. Approximative linear extrapolation lengths are compared with their exact values for a few cases where the latter can be calculated by the one group theory. The upper limit for the multiplication factor is derived by the variational principle, which replaces the one-group diffusion equation in the core and the effective boundary condition. (auth)

7115 A/CONF.15/P/491

THE BARE CRITICAL ASSEMBLY OF NATURAL URANIUM AND HEAVY WATER. Dragoslav Popović (Inst. of Nuclear Sciences "Boris Kidric," Belgrade). 9p.

The zero-energy natural uranium–heavy water bare critical assembly is described. The reactor control, core, and method of approaching criticality are discussed. The reactor is contained in an aluminum tank 1 cm thick supported on an aluminum support frame. Control is achieved by varying the moderator level. (W.D.M.)

7116 A/CONF.15/P/559

THE HALDEN BOILING HEAVY WATER REACTOR. Nils Hidle and Odd Dahl (Inst. for Atomenergi, Kjeller, Norway). 14p.

The project, officially designated as HBWR, was undertaken in 1956 by the Norwegian Institutt for Atomenergi as builder and owner. Project HBWR was conceived as a nuclear power experiment for the studying of the physical and technological aspects of a heavy water moderated reactor under boiling conditions at a power level above 10 Mw thermal. The facility is located at the outskirts of the town of Halden in south-east Norway and on the grounds of one of the large wood processing companies. According to agreement, the company will utilize the steam as generated under experimental conditions. The reactor vessel and the heavy water circuit are designed for 230°C steam operation. Utility steam at 205°C is raised in the secondary light water circuit. About 16 tons of heavy water are contained in the primary circuit, and the initial fuel charge of 7 tons is distributed on a 130 mm hexagonal lattice in the shape of 1 in. diameter rods of natural metallic fuel in finned aluminum cans, fitted in steam shrouds. This initial fuel charge will, for the criticality limitation reason, presumably restrict operations to about 115°C, while 150°C is set as the limit for safe operation with aluminum as canning material. Spiking is planned to bring the reactor up to this temperature. A "second charge" type fuel is required to bring the reactor up to full operating temperature of 230°C. (auth)

7117 A/CONF.15/P/572
VOID EFFECTS IN BOILING HEAVY WATER REACTORS. V. O. Eriksen (Joint Establishment for Nuclear Energy Research, Kjeller, Norway). 12p.

The results of some experiments on the effects of voids in a heavy water moderated reactor, JEEP, are presented. The voids (air) are introduced into annular gaps around a cylindrical fuel element. The void content is varied with a fixed frequency, and the corresponding power modulation is measured and recorded by a reactor oscillator equipment. Using various positions within the core, the spatial dependence of the void coefficient has been determined. (auth)

7118 A/CONF.15/P/581
A MATHEMATICAL MODEL FOR CALCULATING BOILING REACTOR TRANSIENTS. J. A. Fleck, Jr. and J. Huseby (Joint Establishment for Nuclear Energy Research, Kjeller, Norway). 13p.

A mathematical model for calculating boiling reactor transients is presented. The model takes into account the hydrodynamics of a natural circulation boiling reactor in a simple way. The integral forms of the laws of conservation of mass, energy, and momentum in hydrodynamics are used to derive a set of equations coupling circulation velocity, void fraction, and reactor power. The system of equations is used in calculating sample transients for the heavy water boiling reactor being constructed at Halden, Norway. (auth)

7119 A/CONF.15/P/582
A METHOD FOR MEASURING STEAM VOIDS IN BOILING WATER REACTORS. H. Ager-Hanssen and J. M. Dæderlein (Joint Establishment for Nuclear Energy Research, Kjeller, Norway). 8p.

It was found that the thermal neutron flux at the surface of an absorbing rod in a water moderated reactor is highly dependent on the density of the moderator close to the rod. Some experiments to investigate the effect were carried out in a D_2O-moderated reactor. The results indicate the feasibility of utilizing the effect for the construction of a void meter. (auth)

7120 A/CONF.15/P/959
TOLERANCES FOR GROUP-CONSTANTS IN REACTOR CALCULATIONS. H. Grümm and F. Herre (Inst. of Reactor Physics, Stuttgart). 12p.

The main difficulty in the group diffusion theory is the determination of appropriate group constants, based on incomplete and inaccurate figures for cross sections, etc. For a proposed accuracy in the calculation of the critical size it is desirable to know the permissible deviation in group constants from the exact value. On the other hand it is often interesting to know the influence of definite deviations in the group constants on the results of reactor calculations. This problem is worked out by means of the perturbation method for one and two group diffusion theory for a bare and for a reflected reactor. A numerical example and physical discussion are given in the case of large graphite reactor and a small water boiler. (auth)

7121 A/CONF.15/P/960
ON THE EFFECTIVENESS OF DELAYED NEUTRONS IN A REFLECTED REACTOR. D. Emendörfer and K. H. Höcker (Germany). 18p.

The delayed neutrons are produced with less kinetic energy than the fission neutrons. They therefore get thermal inside the reactor with a higher probability than the prompt neutrons, i.e., their influence on the neutron multiplication is more important. The diffusion of prompt and delayed neutrons is treated in a group diffusion approximation. Deriving a single space- and energy-independent kinetic equation from the system of multi-group equations by means of the importance function, an effective fraction of delayed neutrons appears, which is different from the ordinary fraction of delayed neutrons by 20%. (auth)

7122 A/CONF.15/P/967
ON THE THEORY OF CYLINDRICAL AIR GAPS IN NUCLEAR REACTORS. F. Stummel (Reactorstation, Karlsruhe, Ger.). 16p.

An integral part of a research reactor is its central loop, whose design has an important bearing upon the inherent safety of the reactor. The resulting problem is twofold, at any rate in the case of heterogenous reactors. In all cases it is necessary to remove some fuel elements from the original lattice. This results in a large increase in the neutron flux at that point of the loop. With such a neutron flux value the geometry of the channel determines the number of neutrons leaking out of the reactor. The geometry of the channel is treated. (auth)

7123 A/CONF.15/P/968
EXACT TREATMENT OF HETEROGENEOUS CORE STRUCTURES. Kurt Meetz (Reactorstation Karlsruhe, Ger.). 39p.

An infinitely long cylindrical reactor of quadratic cross section is assumed with heterogeneously distributed infinitely long fuel elements arranged in a square lattice. The method for the analytical evaluation of all eigenvalues and eigenfunctions for a regular square lattice in a reactor of quadratic cross section is described. The exact solution shows under what conditions the Wigner-Seitz method is justified. Using the complete solution for a regular lattice, a more general calculus is built up that yields an exact solution even in the case of an irregularity in the lattice, where a Wigner-Seitz treatment is not possible. (W.D.M.)

7124 A/CONF.15/P/1004
STRUCTURE OF THE FUEL ELEMENTS IN THE KARLSRUHE RESEARCH REACTOR FR-2.
A. Boettcher, G. Matz, et al. (Degussa, Frankfurt a.M.). 6p.

The fuel elements for the 12-Mw D_2O research reactor FR-2 consist of massive uranium rods of 216 mm length and 32 mm diameter. The rods are in three parts of identical length and are canned in and bonded to aluminum with a zinc–tin process. The uranium is of defined nuclear purity and is alloyed with 0.3% niobium. Fabrication of the uranium is by extrusion in the gamma phase with subsequent gamma quenching and tempering in the alpha phase. Leak testing is described. (W.D.M.)

7125 A/CONF.15/P/1084
STOCHASTIC MODELS FOR NUCLEAR REACTORS.
A. Medina (Comisión Nacional de Energía Nuclear, Mexico). 10p.

Some simple stochastic models are used for the study of certain kinetic properties of nuclear reactors, under very general assumptions concerning neutron production during the fission process. In absence of retardation, a chain reaction is described by means of a Markov process: solution of the corresponding equation shows that no stationary state of the reactor corresponding to the critical case of the elementary theory really exists, particularly if the macroscopic cross sections are

assumed to be constant. By introducing the population of fissionable nuclei, an approximate steady state is found for which an average reactivity and macroscopic properties can be defined. Introduction of retardation leads to an extended form of the Markov process which is a generalization of an ordinary chain, corresponding to a process exhibiting memory. It is shown that properties of the reactor, as described either by diffusion or transport theories, agree well with the results of stochastic theory only as far as first-order moments of the neutron distribution are involved, but serious discrepancies appear as soon as higher order moments are taken into account. The theory however suggests experiments which can easily be performed for the determination of neutron production moments during the fission process. (auth)

7126 A/CONF.15/P/1092
FLUID FLOW STUDIES OF SIMULATED SUSPENSIONS FOR A LIQUID METAL FUEL SUSPENSION REACTOR. R. C. Cairns (Atomic Energy Commission). 31p.

In order to provide data on the likely pressure loss and settling conditions in pipes, suspensions with particles of high effective density and sub-sieve size were selected for study. Tungsten metal powder in water and precipitated barium sulfate in water were chosen to simulate the U–Na and UBe–Na systems. (W.D.M.)

7127 A/CONF.15/P/1100
A NEW CALCULATING METHOD FOR THE FINE STRUCTURE IN HETEROGENEOUS REACTORS. Lennart Simons (Univ. of Helsinki). 12p.

A new method is presented for the calculation of fine structure in large heterogeneous reactors. The method is applied for calculating the neutron flux in critical cylindrical reactors with cylindrical fuel elements inserted in parallel to the axis in a moderator material. Certain general formulas are drawn up for a cubic lattice of small fuel elements and for a square lattice of thin fuel rods. (W.D.M.)

7128 A/CONF.15/P/1103
CRITICAL CONDITION OF THE BARE HOMOGENEOUS CYLINDRICAL THERMAL REACTOR BASED ON THE P_3-APPROXIMATION OF TRANSPORT EQUATION. E. Tunkelo (Finland Inst. of Tech., Helsinki). 15p.

The calculations are performed to get an idea of the accuracy of the diffusion theory customarily used in reactor calculations. This is done by comparing the results with the calculations of a more accurate method. The comparison is performed in the case of the bare homogeneous cylindrical reactor. First, the constant cross section transport equation is solved with P_3 approximation, which gives the critical condition as a determinant. Then the energy-dependent transport equation is solved with Feynman's method by expanding the solution in terms of the eigenfunctions of the constant cross section approximation. Some numerical calculations are performed. It turns out that the diffusion theory gives a good approximation for large cylinders. (auth)

7129 A/CONF.15/P/1120
A JOINT GOVERNMENT OF ITALY-WORLD BANK STUDY OF A LARGE NUCLEAR POWER PLANT IN SOUTHERN ITALY. Felice Ippolito (Comitato Nazionale per le Ricerche Nucleari, Italy) and Corbin Allardice (International Bank for Reconstruction and Development, Washington, D. C.). 35p.

In July 1957 the Government of Italy and the World Bank agreed to sponsor a joint study of the economic application of a large nuclear power station in Southern Italy. The Study is known as Project ENSI (Energia Nucleare Sud Italia) and involves the selection of a suitable site, the preparation of an invitation to manufacturers and suppliers to bid on the job, the review of tenders and the preparation of reports thereon. Bids are due April 15, 1958. Emphasis is on the over-all approach to the economic application of nuclear power; technical features are not covered. (auth)

7130 A/CONF.15/P/1143
IDEES SUR UN PROJECT DE REACTEUR HOMOGENE. (Ideas About Project of Homogeneous Reactor.) J. Benveniste, J. Bernot, D. Eidelman, M. Grenon, L. Portes, G. Raspaud, L. Rolland, J. Tachon, and G. Vendryes (Commissariat à l'Energie Atomique, Paris), and L. Berthod, Cohen De Lara, M. Delachanal, P. Fontanet, and G. Halbronn (Société Grenobloise d'Etudes et d'Applications Hydrauliques, Grenoble, France). 40p.

The initial results of a homogeneous reactor study are reported. The study is based on the simultaneous use of a uranium suspension in light or heavy water and boiling inside the reactor for heat extraction. Steam will be directly separated in the core by a hydroclone. By inducing a field of tangential speeds, the values of which increase towards the axis, the vorticity accelerates the bubbles towards an axial hole where they are collected. The steam flow is then evacuated from the core to the primary thermal loop. Problems of critical mass and stability were first studied and then power extraction. The results of the calculation led to the design of a small experimental prototype, the Phoebus. (J.S.R.)

7131 A/CONF.15/P/1150
ESSAIS DE TRANSMISSION DE CHALEUR SUR MAQUETTE POUR L'ETUDE DU REFROIDISSEMENT DE LA PILE EXPERIMENTALE EL.3. (Heat Transfer Tests Conducted on Full-Scale Model, to Investigate Cooling Conditions of EL.3 Experimental Reactor.) Butzbach and [P]. Domenjoud (Société Générale de Constructions Electriques et Mécaniques Alsthom, Paris); Raievski and Rolland (Commissariat à l'Énergie Atomique, Paris); Bousquet (Chantiers de l'Atlantique Penhöet-Loire, Paris); Braudeau (Electricité de France, Paris). 23p.

It is assumed that heat flux densities of 2×10^6 kcal/hr/m^2 will occur in the core of the EL-3 reactor. To test the cooling of the uranium fuel elements by heavy water, a series of experiments were made on heat transfer in full-scale models of the EL-3 channels. The test conditions and the experimental apparatus used are described in detail. The results of the tests are graphed with the variation of the density of heat flux transmitted shown as a function of the temperature difference between wall and water and as a function of the temperature difference between wall and water saturation temperature. An interpretation of the results shows that they are in good agreement with the classical Colburn formula. (J.S.R.)

7132 A/CONF.15/P/1151
LE CONTROLE HYGROMETRIQUE DES GAZ DE REFROIDISSEMENT D'UN REACTEUR. (Hygrometric Control of Reactor Cooling Gas.) A. Briot and J. Tourret (Compagnie des Compteurs, Montrouge, France). 23p.

In gas-cooled reactors, the humidity may cause the corrosion of fuel cans, especially if they have a magnesium base. A hygrometric control installation must consist of a measurement station, alarm systems, and a repair station. The factors which determine the choice of a hygrometer are discussed. The operation principles and the performance limitations of a dew-point hygrometer are described in detail. Descriptions are given of the measurement posts and of the alarm stations. The installation of each is discussed. A method for locating the deficient element in the heat exchanger is given. (J.S.R.)

7133 A/CONF.15/P/1161
AUTOMATIC WELDING OF FUEL ELEMENTS. J. Briola (Commissariat à l'Énergie Atomique, Paris). 33p.

The sealing of cartridges by automatic welding is described. The techniques include inert-gas welding used for G-2 reactor cartridges, inert atmosphere arc welding done in an argon-filled plastic vessel where easily oxidized metals are involved, and electronic welding, recommended for small elements used for special purposes and for zirconium. (J.R.D.)

7134 A/CONF.15/P/1164
METHODES DE DETERMINATION DES CONTRAINTES THERMIQUES. QUELQUES EXEMPLES D'APPLICATION AUX REACTEURS. (Methods for Determining Thermal Stresses Values—Some Examples Relating to Nuclear Reactors). J. Bernard, A. Gautier, and A. Peres (Commissariat à l'Énergie Atomique, Paris). 83p.

As modern techniques develop more elaborate machines with higher temperatures and pressures, thermal stresses become a matter of major importance in the design of mechanical structures. In the first part of this paper, the problem of thermal stress is examined theoretically, and an attempt is made to evaluate the aptitudes and limitations of mathematical techniques in calculating thermal stress. Experimental methods of measuring thermal stress in steady and unsteady conditions are described in detail. Some examples relating to nuclear reactors are shown. (J.S.R.)

7135 A/CONF.15/P/1167
ELEMENTS COMBUSTIBLES ENVISAGES POUR LA PILE A HAUT FLUX EL. 3. (Planned Fuel Elements the High Flux EL 3 Reactor). J. A. Stohr, R. Caillat, M. Gauthron, and R. Montagne (Commissariat à l'Énergie Atomique, Paris). 72p.

The EL-3 reactor, which is designed as a high-flux materials testing reactor, will use uranium enriched 1.35 to 1.6% and will be cooled by unpressurized heavy water. Studies on the design of the fuel elements are reported. The advantages of an Al-clad U–Mo fuel were investigated. The mechanical stability of the uranium-can interface would be obtained by crimping grooves and thermopneumatic canning. Mechanical tests and heat transfer tests were made, and the results are reported. The possibility of diffusion bonding of the Al was also studied. In this fuel element there would be an intermediate layer of nickel. A zirconium sheath diffusion-bonded to the fuel was examined. The advantages of using a sodium layer between the bare fuel and the can are discussed. An investigation was made of Al-clad UO_2 pellets. The preparation of the oxide, the effect of the atmosphere on sintering, and the techniq : of sintering are described. (J.S.R.)

7136 A/CONF.15/P/1168
ETUDE GENERALE SUR LES GRAPHITES NUCLEAIRES PRODUITS EN FRANCE. (Some Aspects of Nuclear Graphite Production in France). A. Legendre, J. Gueron, and H. Hering (Commissariat à l'Énergie Atomique, Paris). 25p.

A summary and results on the C.E.A.-Péchiney purification process are given. Variations in the preparation of green pastes and their effects on graphitized material are described. Results are given on statistics of dimensional variation for products having square cross section, statistical variation of thermal expansion coefficients and of electrical conductivity, density of normals to carbon layer planes and their connection with thermal expansion, stress-strain cycles and conclusions drawn from them, and mechanical resistance and gas permeability of items for supporting fuel elements. Modifications under radiation of French graphites irradiated either in G_1 pile or in experimental piles, and thermal annealing of those modifications, are given. (auth)

7137 A/CONF.15/P/1190
METHODS AND EXPERIMENTAL COEFFICIENTS USED IN THE COMPUTATION OF REACTOR SHIELDING. J. Bourgeois, P. Lafore, J. P. Millot, J. Rastoin, and F. De Vathaire (Commissariat à l'Énergie Atomique, Paris). 38p.

The facility used, the computation method applied, and the results obtained in the measurement of the effective neutron stopping cross section are described. A stopping cross section as a function of neutron energy is defined. A computation method to determine the sources of captured gamma rays by the age theory is outlined, and an example of its application in a composite shield is given. (W.D.M.)

7138 A/CONF.15/P/1198
RE-ENRICHMENT OF DEPLETED URANIUM BY PASSAGE THROUGH A GASEOUS DIFFUSION INSTALLATION. Pierre LaGrange and Olegh Bilous (Commissariat à l'Énergie Atomique, Paris). 26p.

An economic study is presented of the re-utilization of depleted uranium from reactors, whether its U^{235} content be above or under natural proportions. Re-utilization is possible either by mixing with a richer concentrate, or by passing it through a gaseous diffusion plant. The economics of passing it through some typical gaseous diffusion facilities are discussed. (W.D.M.)

7139 A/CONF.15/P/1203
"PROSERPINE," A HOMOGENEOUS CRITICAL EXPERIMENT WITH PLUTONIUM. J. Bertrand, P. Bonnaure, C. Clouet d'Orval, J. Corpel, J. de Lemare, P. Lecoustey, I. Prevot, R. Roche, M. Sauve, J. Tachon, and G. Vendryes (Commissariat à l'Énergie Atomique, Paris). 54p.

"Proserpine" is a zero power reactor which uses plutonium as a sulfate solution in light water. The main features of its design are directed towards minimizing the critical mass and towards safety in connection with contamination hazards. The core, beryllium oxide reflector, control devices, and fissile material circuits are described in detail. The experimental criticality studies are discussed. (W.D.M.)

7140 A/CONF.15/P/1204
PILES USED FOR THE NUCLEAR CONTROL OF MATERIALS. V. Raievski, B. Sautiez, B. Bailly du Bois,

O. Tretiakoff, P. Thome, R. Vidal, J. Koppel, and J. Martelly (Commissariat à l'Énergie Atomique, Paris). 30p.

A method for checking the purity of reactor materials is described. The method can be applied to graphite, beryllium oxide, and uranium absorption, as well as the verification of the U^{235} content of fuel elements. (W.D.M.)

7141 A/CONF.15/P/1205
TWO "SWIMMING POOL" REACTORS: MELUSINE AND TRITON. C. Samuel, J. Sauvinet, and A. Virnot (Societe INDATOM, France). 12p.

Brief descriptions of the swimming pool reactors Melusine and Triton are given. The reactors are above ground and are rated as 1000 kw with a flux of 10^{13} $n/cm^2/sec$. The conventional type fuel elements enriched to 20% are made by the Babcock and Wilcox Company. Some of the peculiarities of each reactor are described. (W.D.M.)

7142 A/CONF.15/P/1212
THE CONSTRUCTION OF A SEMI-INDUSTRIAL TYPE GAMMA IRRADIATION FACILITY. F. Balestic, P. Leveque, C. Prevost, and G. Ompte (Commissariat à l'Énergie Atomique, Paris). 14p.

The fuel element cooling chamber of EL3 pile at Saclay has been especially arranged to permit the irradiation of chemical and food products on a semi-industrial scale. Computations have shown that the large quantities of radioactivity stored in this chamber will permit the attaining of a high flux density over a large volume by a special storage arrangement of the fuel elements. The installation is divided into two compartments with differing arrangements of fuel element which allow several irradiation geometries and specimen sizes. The first chamber is constructed of barytes concrete and maintained at a constant temperature. Alternate rows of uranium bars and specimen channels, with a minimum spacing, are used to obtain a compact assembly. The diameters of the channels are 10 and 20 cm and the effective loading height is 70 cm, the latter corresponding to the zone of uniform flux. The second chamber is fitted with a conveyor moving containers 35 cm diameter and 70 cm deep around a single row of twenty fuel elements. The temperature is maintained at −70°C in this latter chamber. The distribution of gamma flux within the chambers was calculated and verified with fuel elements from the EL2 pile at Saclay. The radiation field varies with time following unloading the elements from the pile and depends on the geometric arrangement of elements selected. The predicted theoretical dose rate will range between ten thousand and several million r/hour. These dose rates will be verified with chemical dosimeters of the ferrous sulfate and oxalic acid types. In addition, glass dosimeters calibrated with a cobalt-60 source will be placed in the conveyor container to determine quickly the total integrated dose. (auth)

7143 A/CONF.15/P/1282
LA PRÉDÉTERMINATION DU COMPORTEMENT DANS LES RÉGIMES TRANSITOIRES DU RÉACTEUR DE 2,000 kw DE L'INSTITUT DE PHYSIQUE ATOMIQUE DE BUCAREST. (The Predetermination of Transient State Behavior in the 2,000 kw Reactor of the Bucharest Atomic Physics Laboratory). I. I. Purica (Inst. de Physique Atomique, Bucharest). 19p.

The coefficients for the system of dynamic equations applicable to the reactor as a function of temperature were determined by using two suitably selected transient state situations in the range of small reactivity variations and medium powers. A separation was achieved between the temperature coefficients and reactivity for the moderator and metal, or active volume, respectively, as a function of the temperature. It is possible, by using the coefficients established in this fashion, to determine the behavior of the reactor in dangerous transient-state situations ahead of time and with an adequate degree of precision. A description is given of experiments conducted with the reactor for various transient-state operating situations. (auth)

7144 A/CONF.15/P/1326
STUDY ON THERMAL GROWTH OF VARIOUS CONCRETES CAUSED BY THERMAL CYCLES IN POWER REACTORS. Kenjiro Saji and Eigoro Homma (Nihon Cement Co., Ltd., Japan). 20p.

Startup or shutdown and increasing or decreasing the output of power reactors or high power research reactors cause thermal cycles in the concrete shields. When concrete is subjected to thermal cycling, a phenomenon of thermal growth is observed. Various thermal cycles were investigated for basalt, magnetite, barite, limestone, natural sands and gravels, and copper refinery slag concretes. A mechanism for thermal growth in concrete is proposed. The relations between thermal growth and types of thermal cycles, aggregates, manufacturing methods, thermal properties, and its components were investigated. (W.D.M.)

7145 A/CONF.15/P/1337
REACTOR SIMULATOR BASED ON OPTICAL ANALOGY. Shoji Makishima, Sohachiro Hayakawa, and Takeshi Tomotsu (Tokyo Univ.) and Keiji Naito (Atomic Energy Research Inst.). 39p.

A simple simulator was devised using photons as substitutes for the neutrons. It may be possible to use the primary light and the excited fluorescence for the fast and thermal neutrons, respectively, with about the same accuracy as the two-group theory. The methods of preparation of simulative moderators are given. A comparison is made between the calculations and optical experiments in some simple heterogeneous thermal reactors. The methods are extended to more general cases of heterogeneous reactors. (W.D.M.)

7146 A/CONF.15/P/1338
DYNAMIC ANALYSIS IN START-UP OF A NUCLEAR REACTOR. Tadashi Kagayama (Electrotechnical Lab., Tokyo). 17p.

In discussing wide-range level change of reactors, it is convenient to define a logarithmic power variable which will make it possible to analyze start-up problems as quasi-linear systems. A basic derivation of frequency characteristics in start-up is described that is useful for the analysis and synthesis of reactor control systems. Its application is compared with the analysis by an analog computer. (W.D.M.)

7147 A/CONF.15/P/1379
A STUDY ON A TWO CORES CONVERTER REACTOR. Donatella Baroncini, Arnaldo Chiarini, Anna Maria Manarini, and Ferrante Pierantoni (Istituto di Fisica "A. Righi," Bologna and Scuola di Perfezionamento in Ingegneria Nucleare, Bologna). 34p.

The over-all behavior of a two-region reactor was investigated in the case in which the inner region contains a mixture of fertile and fissionable material and the ex-

ternal region contains natural uranium. It is shown that such a reactor may produce a considerable amount of U^{233}. The calculations are a very crude one-group approximation assuming a spherical geometry. (W.D.M.)

7148 A/CONF.15/P/1383
THE RESEARCH REACTOR OF THE NUCLEAR LABORATORY AT ISPRA, ITALY. S. Barabaschi, A. Bracci, G. Franco, and C. Salvetti (Centro Nazionale per le Ricerche Nucleari, Ispra, Italy). 11p.

Brief descriptions of the reactor, experimental facilities, and building are given. The 5-kw reactor is heavy water cooled and moderated, graphite reflected, and fueled with U^{235} 20% enriched. An account of the present state of the work is given. (W.D.M.)

7149 A/CONF.15/P/1440
GENERALIZATION OF SOURCE-SINK METHODS FOR HETEROGENEOUS REACTOR CALCULATIONS. Hermann Stippel (Univ. of Graz). 14p.

A generalization of the source-sink methods is given by considering not only the highest space symmetric parts of the neutron flux generated by a fuel element as important for its interaction with other fuel elements but also space angular parts which may arise due to lower symmetric construction of the fuel element and to angular dependence of the incident neutron flux which is generated by other fuel elements. (W.D.M.)

7150 A/CONF.15/P/1461
THE PHYSICS OF A MEDIUM FLUX RESEARCH REACTOR. K. Firth, M. Kerridge, R. F. Mathams, A. J. Salmon, K. G. Stephens, A. J. Trott, and J. D. Young (Associated Electrical Industries, Ltd., Aldermaston, Berks, Eng.). 43p.

The physics problems arising in the design of a research reactor, capable of operating at a peak thermal neutron flux of near 10^{14} neutrons/cm^2/sec, are described and discussed. The reactor core calculations, when the core is reflected by either water or beryllia, are considered and results obtained using sub-critical facilities are given. These include temperature coefficients, void coefficients, the effects of voids outside the core, the critical masses for various core configurations and the effects of the plate-type control elements. The designs of the radiation shielding and thermal columns are described, the data and methods used are discussed. Calculations concerning the safety aspects of the reactor are described and discussed, the neutron sources and special instruments developed for this purpose are described. These include a sensitive fission product detector and a very sensitive γ-radiation detector. (auth)

7151 A/CONF.15/P/1462
STABILITY CONSIDERATIONS IN THE DESIGN OF FAST REACTORS. R. T. Ackroyd, J. E. Mann, J. D. McCullen (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.), and G. H. Kinchin (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 36p.

A theoretical study of stability considerations in the design of fast reactors is given and some experiments suggested. Reactor response to impressed sinusoidal, step and ramp additions of reactivity, and to pump failures is discussed. The influence of the magnitude and sign of individual reactivity coefficients on response is considered. The importance of the delay times of these coefficients is stressed and the possibility of self-excited oscillations and resonance instability is examined. Suggestions are made as to the possible sources of unacceptable types of coefficients and hence an indication is given of the design factors which should be kept in mind to ensure that such coefficients are eliminated or reduced to acceptable limits. It is shown that a negative power coefficient of reactivity does not, in itself, ensure stability and that oscillatory stability does not guarantee satisfactory over-all behavior. (W.D.M.)

7152 A/CONF.15/P/1463
THE HIGH TEMPERATURE ZERO ENERGY REACTOR "ZENITH." K. J. Mitchell and R. A. Geary (General Electric Co., Ltd., Erith, Kent, Eng.). 12p.

"Zenith" is a zero energy reactor in which various types of experiments at high temperatures may be carried out in order to obtain data for high temperature gas cooled reactors. In order to produce the expected mean temperatures of core and reflector of larger reactors the circulating coolant gas is electrically heated prior to entering the core and the waste heat is rejected from the system in a gas to water heat exchanger. It is expected to go critical in early 1959. Components described include core and reflector, pressure vessel, gas circuit and blower, control and instrumentation, shielding and containment, charge-discharge, and ventilation plant. (W.D.M.)

7153 A/CONF.15/P/1464
THE A.W.R.E. 5 MW LIGHT WATER MODERATED RESEARCH REACTOR. F. J. Barclay, J. J. McEnhill, and M. C. J. Todd (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). 13p.

The primary function of the 5-Mw light water moderated reactor at AWRE, Aldermaston, is to provide intense neutron beams for physics research and small sample irradiation facilities for radiochemical studies. Fuel elements are similar to those used for the Merlin reactor but the U^{235} content was increased from 10 to 11.5 gm per plate. The layout of the reactor building is given. Construction is expected to be complete in Sept. 1958. (W.D.M.)

7154 A/CONF.15/P/1475
RECENT EXPERIENCE WITH THE KJELLER HEAVY WATER REACTOR JEEP. T. J. Barendregt, U. Been, J. A. Goedkoop, and L. Prytz (Joint Establishment for Nuclear Energy Research, Kjeller, Norway). 10p.

JEEP, the heavy water research reactor of the Netherlands-Norwegian Joint Establishment for Nuclear Energy Research at Kjeller, Norway, has been in operation for seven years without any major difficulties. The reactor is used as a producer of radioisotopes, a source of neutrons for experimental physics, and a reactivity measuring facility. The behavior of the reactor during its operation and the various changes which have been made are discussed. (J.S.R.)

7155 A/CONF.15/P/1483
DETERMINATION OF REACTOR'S SPECTRA BY MEANS OF NUCLEAR EMULSIONS. S. Selim-Younis (Alexandria Univ., Egypt). 16p.

Experiments have shown that nuclear emulsions soaked in light and heavy water can be used to determine the spectra of a reactor. After being exposed to the collimated beam under investigation, measurements of recoil tracks determine the fast neutron spectrum, and backward deuteron photoprotons give the gamma-ray spectrum. This method was applied to the central channel of JEEP at Kjeller, Norway. (auth)

7156 A/CONF.15/P/1584
CONSTRUCTION AND START UP OPERATIONS OF THE FIRST ARGENTINE REACTOR (RA.1). Fidel Alsina Fuertes and Otto O. M. Gamba (Comisión Nacional de Energía Atómica, Buenos Aires). 41p.

The RA-1, which went critical on Jan. 17, 1958, is a heterogeneous reactor which uses 20% enriched UO_2 in aluminum water cooled cans. The fuel is arranged in a circular annular space and the shield, made of cement blocks, is provided outside the graphite reflector. The main differences with respect to the "Argonaut" are described in detail. The theoretical results obtained in the computation of the critical mass and other reactor parameters were compared with the experimental findings and the differences are discussed. A summary of the first experimental work is presented. (W.D.M.)

7157 A/CONF.15/P/1585
THE MANUFACTURE OF FUEL ELEMENTS OF THE ARGONAUT TYPE. J. Kitti, R. E. Machado, J. A. Maxxa, J. Sábato, and I. Silbert (Comisión Nacional de Energía Atómica, Buenos Aires). 18p.

The conditions required for the manufacture of the RA-1 Argonaut type fuel elements are investigated. The fuel elements are in the form of a plate which is manufactured by the extrusion of a presintered mass of U_3O_8 (20% enriched) in an aluminum matrix. Steps in the investigation were obtention and specification of U_3O_8 and Al in powder form for testing, filling and extrusion tests, finishing of the fuel elements, and computation of U_3O_8 content. (W.D.M.)

7158 A/CONF.15/P/1625
THE SWIMMING POOL REACTOR, APSARA. N. B. Prasad and A. S. Rao (Atomic Energy Establishment, Trombay, India). 14p.

The description and reports on the design details of Apsara, the first atomic reactor to go into operation in Asia, are given. The reactor, which is of the swimming pool type, is designed for a maximum power level of one megawatt. It is a very versatile research tool, being provided with a thermal column, 8 experimental holes, a through channel next to the core for oscillation experiments, and a special shielding corner facility. It is being used, among other things, for research in nuclear physics, for the production of radioisotopes, and for the training of personnel. The reactor reached criticality for the first time on August 4, 1956, and experience with its operation in tropical conditions over a period of 18 months is reported. Data on the utilization of the reactor are given. (auth)

7159 A/CONF.15/P/1630
KARLSRUHE RESEARCH REACTOR FR 2. K. Wirtz (Reactor Station, Karlsruhe, Ger.). 40p.

The reactor FR 2 will produce radiation only, not technically useful energy. The fuel consists of 159 metallic rods of natural uranium of 32 mm diameter and 216 cm length. Heavy water serves as moderator and coolant. The core vessel has a diameter of 310 cm and an inner height of 256 cm. The reactor is served by four circuits, the primary D_2O cooling circuit, the secondary H_2O cooling circuit, an air circuit for cooling of the outer thermal shield, and a helium circuit for cleaning purposes and to provide an inert atmosphere inside the tank vessel. (auth)

7160 A/CONF.15/P/1673
THE BR-1 PILE. PART I. DESCRIPTION AND USE. G. Stiennon. PART II. PHYSICAL CHARACTERISTICS. M. Neve de Mevergnies, C. Fairclough, G. Stiennon, and F. Leonard (Centre d'Etude de l'Energie Nucleaire, Brussels). 62p.

The BR-1 reactor which was built at Mol (Belgium) is described in detail. This is a graphite-moderated reactor which uses natural uranium. Cooling is by air, using an open circuit. It operates at a power of 5 Mw. The experimental possibilities and program for use of the reactor are reviewed, along with the special research equipment. An experiment to measure the spectral distribution of slow neutrons in the uranium–graphite lattice is described. The transfer function of the reactor was measured in order to determine the mean lifetime of the neutrons in the pile. The diffusion length of thermal neutrons in the core was measured. (W.D.M.)

7161 A/CONF.15/P/1679
BR-2 THE BELGIAN MATERIALS AND ENGINEERING TEST REACTOR. H. Dopchie and J. Planquart (Centre d'Etude de l'Energie Nucléaire, Brussels). 66p.

The BR-2 reactor, which should become critical around the end of 1959, will be light-water-cooled and -moderated, fueled with uranium enriched to 90%. Its cylindrical fuel elements, imbedded in a beryllium matrix, constitute a nest in the form of an hyperboloid of revolution. The reactor has been designed to facilitate the manipulation of the fuel elements and the experiments. Besides fuel elements, control rods, beryllium plugs, and experiments can occupy any position in the matrix. The reactor is described, and the reasons for the choice of its type are given. Its characteristics and experimental facilities are discussed. The research and development necessitated by its new design are described. Its safety is examined. (auth)

7162 A/CONF.15/P/1680
ANALYSE SPECTRALE DES NEUTRONS RAPIDES A L'INTERIEUR DE BR-1. (Spectral Analysis of the Fast Neutrons Inside the BR-1 Reactor.) C. Beets, H. Breny, and J. Fournaux (Centre d'Etude de l'Energie Nucléaire, Brussels). 38p.

The energy distribution of fast neutrons in a reactor is a fundamental datum which may be analyzed by nuclear emulsion beyond 250 kev. A measurement of two distributions at the interior of the BR-1 reactor was made at points of an elementary cell placed near the core of the reactor. One was at the center of the lattice in the graphite and the other was at a point near a rod. A detailed analysis made it possible to determine the corresponding neutron spectra from these results. (J.S.R.)

7163 A/CONF.15/P/1704
CANADA-INDIA REACTOR. R. D. Sage and D. D. Stewart (Atomic Energy of Canada, Ltd., Chalk River, Ont.); N. B. Prasad and H. N. Sethna (Atomic Energy Establishment, Trombay, India). 43p.

The Canada-India Reactor is discussed, particularly as regards the features that differ from their NRX counterparts. The core is basically the same, but the building, cooling water system, shielding rooms, ventilation, and other features have been redesigned. The control and safety system is of particular interest, because reactor control will be by heavy water level adjustment instead of by a control rod. A description is given of the attached laboratory and other associated and auxiliary facilities, together with a brief account of the layout of the entire Trombay Establishment, into

which the Canada-India Reactor complex fits. The progress of the construction work is described. (auth)

7164 A/CONF.15/P/1711
PROBLEMS OF NEUTRON MOVEMENTS IN ATOMIC REACTORS ACCORDING TO THE THEORY OF PROBABILITIES. J. Mogyoródi (Hungarian Academy of Sciences, Budapest). 7p.

A mathematical model for dealing with the random variable of neutron path length in a moderator is given. The probability is determined that the length of path should not exceed a certain value (R) while the neutron lethargy increases to some value. The probability in question is given in the form of a power series in R, where the coefficients may be determined with the aid of a recursive formula. (W.D.M.)

7165 A/CONF.15/P/1805
BEPO WIGNER ENERGY RELEASE. J. L. Dickson, G. H. Kinchin, R. F. Jackson, W. M. Lomer, and J. H. W. Simmonds (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 97p.

The second Wigner energy release in the 6-Mw air-cooled graphite-moderated research reactor BEPO took place on 14-15th March 1958. The release was fully instrumented, and a preliminary analysis of the results shows the release to have been very complete. The reasons for the chosen method of release, the analysis and interpretation of the graphite sampling data from which the maximum anticipated release temperatures were predicted, and the various safety considerations of graphite oxidation and uranium cartridge failure under these maximum temperature conditions are described. The engineering arrangement for the conduct of the release are described followed by a description of the release and the temperature data obtained. (W.D.M.)

7166 A/CONF.15/P/1815
ON THE NON-LINEAR STABILITY OF A NUCLEAR REACTOR WITH DELAYED NEUTRONS. Rui Pacheco de Figueiredo (Junta de Investigações do Ultramar, Lisbon). 6p.

A nuclear reactor with non-uniform distribution of delayed neutrons and constant power extraction is discussed, and it is shown rigorously that the non-linear differential equations that describe the system have no periodic solutions other than the trivial set of solutions corresponding to constant reactor power and temperature. (W.D.M.)

7167 A/CONF.15/P/1828
DEVELOPMENT OF A 250 kW AQUEOUS HOMOGENEOUS SINGLE REGION SUSPENSION REACTOR. P. J. Kreyger, Th. van der Plas, B. L. A. van der Schee, J. J. Went, and J. J. van Zolingen (R.C.N.-K.E.M.A. Reactor Development Group, Arnhem, Netherlands). 43p.

The reactor (20% enriched U^{235}) is pressurized with hydrogen up to 20 atm overpressure and has a maximum working temperature of about 250°C. The process flowsheet, including the systems for fission product removal, is presented. Xenon is removed directly by gas stripping and indirectly by removal of iodine. Thermal and flow quantities are used for control of the reactor. The neutron flux is measured but not used for control purposes. (W.D.M.)

7168 A/CONF.15/P/1894
NEUTRON STUDIES AT APSARA. M. G. Bhide, A. W. Pereira, B. M. Udgaonkar, N. Umakantha, and R. Vedam (Atomic Energy Establishment, Trombay, India). 23p.

Neutron studies, theoretical and experimental, carried out with the swimming pool reactor, APSARA are reported. The results of the calculations of critical masses and fluxes in some configurations of the core, with and without holes at the center, are presented and compared with experiment. Neutron fluxes in the thermal column and in the water of the tank were measured; and the temperature coefficient, power coefficient, and transfer function were obtained. (auth)

7169 A/CONF.15/P/1896
DETERMINATION OF REACTOR TRANSIENTS AND TIME VARIATION OF CORE MATERIAL CONCENTRATION AND EXCESS REACTIVITY BY GRAPHICAL METHOD. P. Stiévenart and P. Erkès (Bureau d'Etudes Nucléaires, S. A., Brussels). 18p.

The graphical method described is a development of the Bergeron principle for the solution of the differential equations with variable coefficients which define the reactor transients, the variation of core material concentrations, and excess reactivity with core life. The precision of the results obtained is sufficient for the application of this graphical method to solve some problems encountered in reactor design. (W.D.M.)

7170 A/CONF.15/P/1949
STUDIES OF MULTI-ZONE U-D_2O LATTICES. Manohar G. Bhide (Atomic Energy Establishment, Trombay, India). 10p.

The proposed Indian zero-energy D_2O reactor (ZERLINA) will have a core diameter of about 2.3 meters. The purpose of this study is to consider the feasibility of increasing its usefulness by arranging the fuel in two zones. The possibility is discussed of studying lattices with very low material buckling by surrounding them with a high buckling lattice forming the outer zone. The use of the reactor for cross-section measurements in an essentially pure thermal neutron flux by carrying them out in a fuel-free zone at the center of the reactor is considered. It is expected that it is possible to get such a zone of radius of about 60 cm with a ratio of thermal to fast flux of approximately 400. (auth)

7171 A/CONF.15/P/2036
CRITICAL TEST CONDUCTED ON A HEAVY-WATER EXPERIMENTAL REACTOR. PART I. THEORY. A. D. Galanin, S. A. Nemirovskaya, and A. P. Rudik. **PART II. EXPERIMENT.** Y. G. Abov, V. R. Belkin, and P. A. Krupchitskii (Krupchitsky) (U.S.S.R.). 31p.

Calculations for a heavy water heterogeneous reactor critical experiment are outlined. The calculations were made by homogeneous equations, but a correction is introduced for heterogeneity obtained by solving heterogeneous equations for an idealized model. The results of the calculations are compared with the test, and an appraisal is given of the accuracy of the initial constants. (auth)

7172 A/CONF.15/P/2091
SOOBSHCHENIE O EKSPERIMENTAL'NOM REAKTORE I OSNOVNYE DANNYE O PROEKTE INSTITUTA YADERNOI FIZIKI CHEKHOSLOVATSKOI AKADEMII NAUK. (Experimental Reactor of the Nuclear Physics Institute of the Czechoslovak Academy of Sciences). J. Neumann, Č. Šimáně, M. Weber, J. Urbanec, P. Kovanic, F. Červinka, and R. Hejlek (Czechoslovakia). 15p.

Certain criteria concerning the selection of the building-site are given. Devices of the experimental

reactor are described. Measures for preventing escape of radioactive waste waters are examined. Reactor data, including those concerning critical mass, based on results of test operation and certain results of measurements are indicated. (auth)

7173 A/CONF.15/P/2104
PRIBLIZHENNOE RESHENIE URAVNENII KINETIKI REAKTORA. (An Approximate Solution of Reactor Kinetics Equations). P. Kovanic (Czechoslovakia). 22p.

A method is proposed for a simplified solution of reactor kinetics equations, consisting in the use of the method of successive approximations. The first approximation is derived for the transient process in a reactor after long operation at constant power and for constant reactivity. Physical consideration shows that the success of the proposed mathematical method is based on the well-known phenomenon that the number of nuclei emitting delayed neutrons cannot follow immediately the instant neutron flux in the reactor. The error of the first approximation is very small at the beginning of the process and increases in the course of the continuing process. The solution of the kinetics equations for reactivity dependent on time is derived from the first approximation valid for constant reactivity by means of the Duhamel integral. A simple differential equation of the reactor kinetics resulted, which is valid for reactivity varying in time with the assumption of small deviations of the reactor multiplication factor from one. This equation may be used for characterizing the transient processes in any reactor, if these processes take a sufficiently short time. The derived simplified reactor kinetics equation may be used especially for solving automatic reactor control both by direct solution of differential equations and by operator method. The use of this simplified equation requires less time than usual approximations, while it preserves the qualities typical of the given process. (auth)

7174 A/CONF.15/P/2105
PHYSICAL DATA FOR DESIGN OF H_2O AND D_2O MODERATED HOMOGENEOUS REACTORS. J. Roček and V. Bartošek (Czechoslovakia). 25p.

The results of calculations of some physical parameters for homogeneous reactors are given. The paper deals with critical size and critical masses, temperature coefficient, and kinetics calculations for a heavy and light water reactor fueled with U^{238} enriched with U^{235} or Pu^{239}, which are made for various degrees of fuel enrichment, fuel concentration in the moderator, and for four temperatures from 293 to 600°K. In view of the large number of calculated cases a modified one-group method was used for the determination of critical sizes. Calculations concerning certain variants of a light water reactor with U^{235} were carried out with the three-group method. For some important cases kinetics are calculated. The change of isotopic fuel composition, chemical composition of the mixture, and the time of operation under different ways of mixture cleaning and fuel exchange are examined. (auth)

7175 A/CONF.15/P/2129
EXPERIMENTAL FAST REACTORS IN THE SOVIET UNION. A. I. Leipunskii (Leipunsky), V. G. Grabin, N. N. Aristarkhov, et al (U.S.S.R.) 32p.

In accordance with the general program aimed at fast reactor development, experimental reactors BR-1, BR-2, and BR-5 of 30 w, 150 kw, and 5 Mw, respectively, have been constructed and put into operation. The reactor and experimental programs are described. Preliminary design parameters are given for the proposed sodium-cooled 200 and 250 Mw power reactors BN-50 and BN-250. (W.D.M.)

7176 A/CONF.15/P/2141
ON THE APPLICATION OF THE METHOD OF RANDOM TESTS. THE MONTE CARLO METHOD FOR THE SOLUTION OF THE KINETIC EQUATION. I. M. Gelfand, S. M. Feinberg, et al. (U.S.S.R.). 10p.

For applications, it is frequently sufficient not to know the solution of the kinetic equation itself, but only one or several numerical characteristics determined by this solution. It is usually possible to record such a characteristic in the form of path integral from the space of particle paths and to use the Monte Carlo method for its computation. Various methods are discussed of recording path integrals and methods of their transformations as well as approximation of path integrals with multiple integrals. Various techniques for carrying out random experiments, in particular independent ones, are given. Demands which should be presented to the sequence of pseudo-random numbers are discussed. Some problems which can be solved by the methods presented are considered. (auth)

7177 A/CONF.15/P/2142
AN INTERMEDIATE REACTOR FOR OBTAINING HIGH INTENSITY NEUTRON FLUXES. S. M. Feinberg, E. D. Vorobiev, et al. (Academy of Sciences, U.S.S.R.). 85p.

An intermediate research reactor designed for obtaining high thermal and fast neutron fluxes is described. The reactor consists of a core with plate fuel elements containing highly enriched uranium. The fuel elements are cooled by water flowing through the gaps between the plates. The core is surrounded by a reflector of beryllium oxide. In the center of the core there is a water thermal column where the maximum thermal neutron flux is produced. The ratio of the maximum neutron flux to heat output characterizing the performance of the research reactor is several times greater than that for thermal reactors. Theoretical premises for the use of intermediate reactors are given and their advantages are shown. The results of experiments with critical assemblies carried out with the aim of studying uranium–water intermediate reactor physics are discussed. (auth)

7178 A/CONF.15/P/2146
PHYSICAL CHARACTERISTICS OF BERYLLIUM MODERATED REACTOR. A. K. Krasin, B. G. Dubovskii (Dubovsky), et al. (U.S.S.R.). 33p.

Experiments for the determination of critical charge and multiplication parameters of beryllium-moderated reactors are described. Multiplication factor resulting from the reaction (n,2n) in beryllium is measured. Periods and yields of the delayed photoneutrons resulting from the reaction (γ,n) in beryllium are studied. (auth)

7179 A/CONF.15/P/2151
NUCLEAR REACTOR PHYSICAL PROBLEMS AND CALCULATION METHODS. G. I. Marchuk, V. J. Pupko, et al. (U.S.S.R.). 41p.

Physical characteristics of homogeneous reactors depending on concentration of fissionable material in the moderator are compared. The numerical method of solution of the kinetic equations in the P_3 approximation of the spherical harmonics method is described. A coarse method of calculation for the neutron flux space and energy distribution and for the neutron values in the

low-energy range where the thermal motion of nuclei in the moderator is essential is discussed. (auth)

7180 A/CONF.15/P/2185
SOME NEW AND RECONSTRUCTED RESEARCH THERMAL REACTORS. V. V. Goncharov, et al. (U.S.S.R.). 151p.

Descriptions are given of the reconstructed research reactors RFT (H_2O and graphite moderated), VVR-2 (H_2O moderated, 3 Mw), and TR (D_2O moderated, 2.5 Mw). The new reactors described include ERT (H_2O, 2 Mw), VVR-M (H_2O, 10 Mw), and VVR-TS (H_2O, 10 Mw). (W.D.M.)

7181 A/CONF.15/P/2256
FISSION PRODUCTS IN COOLING WATER OF THE BRAZILIAN SWIMMING POOL REACTOR. Fausto W. Lima, Alcídio Abrão, Laura Tognoli, and Constância Pagano (Inst. de Energia Atomica, São Paulo, Brazil). 22p.

The identification of the radioactive nuclides found in the water of the swimming pool Brazilian reactor is studied. The chemical procedures used are described. Identification of the nuclides was made by measurement of half life and gamma spectrometry. Evidence seems to indicate that diffusion of gaseous fission products into the cladding is the origin of fission products in the water. (auth)

7182 A/CONF.15/P/2273
A POWER CALIBRATION METHOD USING THE XENON POISONING. Marcello Damy de Souza Santos and Paulo Saraiva de Toledo (Inst. de Energia Atômica, São Paulo, Brazil). 8p.

A method of power calibration using the reactivity variation due to xenon poisoning is developed. Two cases are considered: reactivity variation after reacting the xenon equilibrium poisoning; time variation of reactivity due to the non-equilibrium xenon poisoning. Both methods are applicable in the high flux region. In the second method some care must be taken in order to avoid the influence of the temperature reactivity variation. The application of the second method to the power calibration of the IEA R-1 reactor in the Mw region is considered, and the results are compared with the temperature differential and flux plot method. (auth)

7183 A/CONF.15/P/2274
DESCRIPTION OF THE BRAZILIAN RESEARCH REACTOR. Marcello Damy de Souza Santos and Paulo Saraiva de Toledo (Inst. de Energia Atômica, São Paulo, Brazil). 15p.

The experimental program is outlined, and a detailed description of the reactor and its buildings is presented. (A.C.)

7184 A/CONF.15/P/2275
RADIATION INTENSITY LEVELS AND AIR AND WATER ACTIVITIES OBSERVED WITH THE IEAR-1 SWIMMING POOL REACTOR AT 5 MW. R. R. Pieroni, S. B. Herdade, Wilma S. Hehl, and C. R. Pereira (Inst. de Energia Atômica, São Paulo, Brazil). 5p.

Beta and gamma activities both in air and in airborne particulate were measured during the operation of the IEAR-1 swimming pool reactor at 5 Mw. The obtained results are presented and it is shown that the decay curve is characteristic of a fission product activity. The results are also compared with activities observed in the pool water. The possible causes of such an activity are analyzed and it is shown that the activities should be attributed to uranium contamination on the outside of the fuel cladding plates, most probably originated during the manufacturing process. The beta, gamma, and neutron levels in all the reactor building areas are presented. It is shown that a high activity is observable at the pool surface due to the turbulent motion of the water in the forced cooling regime. (auth)

7185 A/CONF.15/P/2276
THE $Be^9(n,2n)Be^8$ REACTION AND ITS INFLUENCE ON THE INFINITE MULTIPLICATION FACTOR FOR BERYLLIUM MODERATED HETEROGENEOUS THERMAL REACTORS. Darcy Dillenburg, Gerhard Jacob, and Paulo Saraiva de Toledo (Inst. de Energia Atomica, São Paulo, Brazil). 12p.

The influence of the $Be^9(n,2n)Be^8$ reaction on the infinite multiplication factor of heterogeneous thermal reactors using beryllium as moderator is considered. The distortion of the fission neutron spectrum due to collisions either in the natural uranium bars or in the moderator is taken into account. The estimate of the effect is made using the differential cross section for the $Be^9(n,2n)Be^8$ reaction obtained by G. Fischer, and values of the order of 7% are obtained. (auth)

7186 A/CONF.15/P/2279
PRELIMINARY RESULTS OF 5 MW OPERATION WITH THE BRAZILIAN SWIMMING POOL REACTOR. Marcello Damy de Souza Santos, Paulo Saraiva de Toledo, Fausto Walter Lima, et al. (Inst. de Energia Atômica, São Paulo, Brazil). 10p.

Preliminary results of operation at powers of one, two and one half, and five megawatts with the IEA R-1 swimming pool reactor are described with the different methods used for power calibration. Both air and water activities were analyzed, and some nuclides responsible for the observed activities were identified. (auth)

7187 A/CONF.15/P/2297
DISASSEMBLY OF EXPERIMENTAL URANIUM–GRAPHITE ISOTOPE REACTOR AFTER FOUR YEARS OF OPERATION. B. B. Brohovich, F. I. Ovchinnikov, V. I. Klimenkov, P. V. Glazkov, and B. M. Dolishnyuk (U.S.S.R.). 29p.

The principal stages in the disassembly of the reactor (I.R.), the individual safety measures, the effectiveness of these measures, and the state of reactor design units are described. Particular attention was given to the state of reactor masonry in connection with the destruction of fuel elements. (W.D.M.)

7188 A/CONF.15/P/2344
ON THE DEFINITION OF THE EXTRAPOLATED SURFACE FOR BARE HOMOGENEOUS THERMAL REACTORS. E. Inönü (Univ. of Ankara). 15p.

An attempt is made to obtain an average transport mean free path for neutrons, to be used in the definition of the extrapolated surface for bare homogeneous thermal reactors. A many-group theory is applied in which fluxes in each group extrapolate to zero on a slightly different surface. The chain process is expressed by means of non-escape probabilities in the groups and transformation matrices that connect the flux eigenfunctions in adjacent groups. By solving the eigenvalue equation to first order in λ/L, where λ is the largest of the mean free paths and L is the shortest distance from the center of the reactor to its surface, a criticality relation is obtained. From this relation an average mean free path $\bar{\lambda}$ is derived, which, if used in the ordinary many-group criticality equation, would give the same relation for the critical values of the geometrical parameters. (auth)

7189 A/CONF.15/P/2411
THERMAL FLUX IN THE CENTRAL MODERATOR-ZONE OF THERMAL AND FAST REACTORS.
M. Osredkar (J. Stefan Inst., Ljubljana, Yugoslavia) and R. Stephenson (New York Univ.). 26p.

To see the feasibility of the proposed assembly, the behavior of the thermal flux in the central moderator-zone of thermal reactors was investigated. The system having a pure-fuel fast core with the absorber at the interface was compared to systems without the absorber. A blocking layer (light water and the absorbing shell) was studied separately. The system with diluted fuel was investigated and the influence of the central moderator-zone on kinetics of the proposed system estimated. The two group diffusion theory in spherical geometry was used in calculations. (W.D.M.)

7190 A/CONF.15/P/2417
THE EFFECTIVE NEUTRON ABSORPTION PROPERTIES OF SOME REACTOR CONSTRUCTION MATERIALS. Pelw E. Blomberg (AB Atomenergi, Stockholm). 13p.

A series of pile oscillator measurements was made on commercial metals and alloys using Swedish Reactor R-1. The aim was to check the agreement between the calculated and measured thermal neutron absorption cross sections. The cross sections were computed from the composition determined by chemical analyses, using the cross sections of the elements compiled in BNL-325. Results are given for various low-alloy constructional steels, austenitic Cr–Ni steels (stabilized and unstabilized), and aluminum alloys. (W.D.M.)

7191 A/CONF.15/P/2424
THE CANADA-INDIA REACTOR: AN EXERCISE IN INTERNATIONAL CO-OPERATION. W. B. Lewis (Atomic Energy of Canada, Ltd., Chalk River, Ont.) and H. J. Bhabha (Dept. of Atomic Energy, Bombay). 6p.

Canada and India are coöperating in the construction of a research and engineering test reactor of the NRX type to operate at 40 Mw(th). A brief description of the reactor located at Trombay is given, and the essential differences with NRX discussed. The costs of the project are shared equally by Canada and India under the Colombo Plan. (W.D.M.)

7192 A/CONF.15/P/2458
SUR LA STABILITE INHERENTE DES REACTEURS NUCLEAIRES. (The Inherent Stability of Nuclear Reactors.) V. M. Popov (Rumania). 16p.

The most generalized conditions of inherent stability for homogeneous reactors are established. The nonlinear relation existing between the temperature and the reactivity is considered by taking into account the presence of six groups of delayed neutrons. The second method of A. M. Liapounoff is used to construct a function of variables of the system. The results are applied to a consideration of the inherent stability of heterogeneous reactors. (J.S.R.)

7193 A/CONF.15/P/2469
OPREDELENIE EFFEKTIVNOSTI ORGANOV REGULIROVANIYA V TSILINDRICHESKOM REAKTORE. (Determination of the Efficiency of Control Elements in Cylindrical Reactors.) G. V. Sinyutin and V. G. Semenov (U.S.S.R.). 29p.

The efficiency of a finite number of controlling rods introduced for compensating reactivity variations in the active zone of reactors of finite dimensions was determined. (R.V.J.)

7194 A/CONF.15/P/2485
THEORY OF ANNEALING KINETICS APPLIED TO THE RELEASE OF STORED ENERGY FROM IRRADIATED GRAPHITE IN AIR-COOLED REACTORS. A. H. Cottrell, et al. (Atomic Energy Research Establishment, Harwell, Berks, Eng.); and J. C. Bell and G. B. Greenough (United Kingdom Atomic Energy Authority, Sellafield, Cumb., Eng.). 56p.

The release of stored energy is due to the movement and elimination of lattice defects. A theory is presented of the factors which enable the rate and amount of release to be estimated, for a variety of reactor conditions, in terms of measurements made under a limited set of laboratory conditions. This theory is used to assess various possible methods for operating and annealing graphite moderated reactors so as to avoid both accidental releases of stored energy and unduly high temperatures during deliberate releases. (W.D.M.)

7195 A/CONF.15/P/2502
EXPERIMENTAL REACTOR WITH GASEOUS FISSIONABLE SUBSTANCE (UF_6). I. K. Kikoin, V. A. Dmitrievskii (Dmitrievsky), Y. Y. Glazkov, I. S. Grigoriev, B. G. Bubovskii (Bubovsky), and S. V. Kersnovskii (Kersnovsky) (U.S.S.R.). 23p.

An experimental reactor using UF_6 as fuel is described. The reactor is heterogeneous, beryllium moderated, and graphite reflected. Using 90% enriched uranium, criticality was achieved at approximately atmospheric pressure. Possibilities of continuous plutonium and fission product extraction and of using the UF_6 as a coolant and prime mover are discussed. Photographs of the reactor are given. (W.D.M.)

Power

7196 A/CONF.15/P/15
GRAPHITE MODERATED THERMAL REACTOR CALCULATIONS FOR THE CALDER HALL REACTORS.
P. W. Mummery, J. J. Surett, and J. G. Tyror (Atomic Energy Research Establishment, Harwell, Berks, Eng.), and B. Cutts (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). 30p.

The methods of calculation on which the Calder work was based together with their correlation with integral experiments are presented. The calculations are compared with the results of the commissioning experiments and explanations are suggested for the discrepancies. Attention is drawn to the difficulties of extending the system of calculation to reactor fuels containing plutonium and a provisional method for this is described. A new proposal for a system of lattice calculations requiring a new correlation with integral experiments is outlined. (auth)

7197 A/CONF.15/P/21
THE DERIVATION OF REACTOR HEAT TRANSFER TRANSIENT EQUATIONS FOR GAS COOLED GRAPHITE MODERATED THERMAL REACTORS. T. J. O'Neill (General Electric Co., Ltd., Erith, Kent, Eng.). 28p.

In making transient studies on the behavior of gas-cooled graphite moderated thermal reactors, one of the sets of mathematical equations involved is that for reactor heat transfer. These equations have for inputs: reactor power reactor gas flow and reactor inlet gas temperature; and produce as output: reactor outlet gas temperature, the uranium and graphite reactivity affecting variables, and the maximum fuel element tem-

peratures. From the consideration of a unit length of one fuel element channel in the core, partial differential equations of the system are determined. These are integrated in space, to give the form required for analogue computer studies, i.e., simultaneous ordinary non-linear differential equations. The final equations are given for two variants in moderator design, viz: a solid-block type of moderator, and a moderator involving in part a graphite fuel element supporting sleeve. Account is taken of heat transfer by conduction in the solids, and by convection and thermal radiation in and between the gas spaces.

7198 A/CONF.15/P/37
PROBLEMS OF FUELLING IN INDUSTRIAL CALDER HALL TYPE REACTORS. R. R. Gallie and H. H. Gott (Atomic Energy Research Establishment, Harwell, Berks, Eng.) and F. C. W. Colmer (Central Electricity Generating Board, London). 33p.

The two main problems treated are the utilization of the initial fuel charge and the prediction of the statistical relation between bursts and burn-up and to draw the correct conclusions from this prediction. It is clear, however, that this prediction is largely a problem of the accumulation of operating experience and initial estimates are not likely to be precise. Attention is drawn to the practical problems, although the treatment is largely mathematical. (W.D.M.)

7199 A/CONF.15/P/38
A CORRELATION OF HEAT TRANSFER FOR FINNED FUEL ELEMENTS FOR CARBON DIOXIDE REACTORS. D. F. Hughes and M. R. Slack (Atomic Power Projects of the English Electric Co. Ltd.; Babcock and Wilcox Ltd.; and Taylor Woodrow Ltd., Whetstone, Leics, Eng.). 24p.

In the course of development of fuel element cans for gas cooled reactors a type of finning has been evolved comprising multistart helical fins intersected by longitudinal splitters. The flow pattern associated with this type of finning is discussed and the method of testing is described. As the result of tests on a wide range of geometrical arrangements of this finning in different channel sizes it was possible to produce empirical correlations of heat transfer and friction factor. Examples for a series of cans of 2 inches external diameter in a variety of channel sizes are presented. (auth)

7200 A/CONF.15/P/44
THE MANUFACTURE OF FUEL ELEMENTS FOR THE DOUNREAY FAST REACTOR. C. J. Turner and L. R. Williams (United Kingdom Atomic Energy Authority, Springfields, Lancs, Eng.). 32p.

The initial fuel element design was based on the use of an outer niobium tube and a vanadium inner tube, the highly enriched uranium being contained between these two in the form of annular sections. This design has remained substantially unaltered throughout the development period. An assessment of the complex problems associated with the production of such a fuel element is given. These included full metallurgical development of the two metals niobium and vanadium. A description of the development programs associated with the production of the fuel, canning materials, and assembly techniques is given, together with an account of the development of inspection and testing techniques for both the individual components and the completed fuel element. (auth)

7201 A/CONF.15/P/53
ANALYTICAL METHODS FOR EVALUATING FLUX DISTRIBUTION IN SMALL POWER PRODUCING REACTORS. A. Jeffrey (Rolls-Royce Ltd., Littleover, Derby, Eng.). 12p.

The problems of criticality and flux distributions in a small light water moderated power producing reactor in which the fuel elements are surrounded by control absorbers partially inserted into the core are solved by converting the partial differential equations and boundary conditions involved to an integral equation by use of suitable Green's functions. Flux distributions and criticality conditions are computed for various absorber insertions and curves are given relating the sensitivity of the infinite reproduction constant to the extrapolation length assumed at the absorber. (auth)

7202 A/CONF.15/P/54
ECONOMICS OF ENRICHMENT AND OF THE USE OF PLUTONIUM AND U-233. N. L. Franklin, J. M. Hill, and J. C. C. Stewart (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.), and C. A. Rennie (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 18p.

A standard for comparison, the gas-cooled reactor using natural uranium metal fuel is adopted. A brief survey of the cost structure of power produced from such a reactor is given. The effect of the fuel cycle and the reactor size upon the expected reactivity performance using natural uranium fuel is discussed. The cost structure in the production of enriched uranium is reviewed and a typical cost enrichment curve is deduced for the range 0.5 to 2.0 Co. Typical fuel element costs, inventory costs, and repurchase values are presented. The general principles of the use of plutonium in place of uranium 235 are considered for conditions of total plutonium recycle and for plutonium-natural uranium fuels. The major differences between such systems and systems using enriched uranium are discussed under the headings of: Fuel element fabrication and processing; The choice of spikes or uniform enrichment; The nuclear performance of plutonium as a substitute fuel; and The effect upon reactor operation. These considerations are combined to provide estimates of the relative economic worth of plutonium and uranium 235 enrichment. The general principles of the use of uranium 233 as a fuel are outlined. (auth)

7203 A/CONF.15/P/55
KINETIC AND CONTROL OF THE BERKELEY REACTORS. J. M. Yellowlees and P. R. J. French (AEI-John Thompson Nuclear Energy Co., Ltd., Knutsford, Ches., Eng.).

Requirements are listed for the over-all plant load control system. To meet these conditions the design of the over-all control system must be coordinated with that of the plant mechanical details, reactor protection system, and station electrical system. The design of the control and protection system of the Berkeley Nuclear Power Station is summarized, and certain characteristic reactor transient conditions are described. (W.D.M.)

7204 A/CONF.15/P/72
ECONOMICS OF NUCLEAR POWER. J. A. Jukes (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 14p.

A large amount of data on the economics and costs of different reactor systems was presented at the 1955

Geneva Conference on Peaceful Uses of Atomic Energy. This paper discusses the changes which have taken place since then as a result both of the experience in the actual construction of stations and through theoretical studies. In the light of this experience the paper reviews the extent to which it is now practicable to quote realistic costs for nuclear power. The geographical situation is shown to be of great importance. Apart from differences in the costs of construction in different places, there are important differences in the cost of obtaining capital and in the accounting conventions. Big cost differences also occur through variations in load factor and in the size of the electricity demand. Capital costs are the part of the costs of nuclear power which can be assessed most accurately. But these depend upon the ability to make good estimates; the capital costs of many nuclear power stations, planned or under construction, have been revised upwards during the last three years. Accurate estimates can only be made when a design has been completed. Running costs are much more difficult to estimate. The cost of the wages of the operating staff is small, but some uncertainty surrounds the cost of maintenance. The major uncertainty is, however, the cost of the fuel because fuel elements of standard production design cannot be tested in advance under normal operating conditions to full burn-up. Present predictions have necessarily to be based on the extrapolation of data obtained from lower burn-ups or from experimental fuel elements irradiated under special conditions. The soundness of the predicted burn-ups can only be judged by a detailed study of the experimental evidence. Operating experience with a given reactor should enable successive marks of fuel elements to show improved performance. (auth)

7205 A/CONF.15/P/73
CURRENT RE-DESIGNS OF CALDER HALL. J. B. W. Cunningham. Includes Appendix: LEAKAGE OF CO_2 FROM THE PRESSURE CIRCUIT OF THE CALDER HALL REACTORS. H. V. Disney (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). 19p.

The first re-design of the Calder Hall reactors was carried out by industrial firms in Britain for U.K. electricity authorities. The U.K. Atomic Energy Authority collaborated with the electricity authorities in writing the specification for these stations and in assessing the designs. The method adopted for carrying out the assessment is described. It involved a detailed consideration of each design from a number of different aspects, namely: performance, safety, fuel elements, pressure circuit, control and instrumentation, graphite structure, burst cartridge detection, and civil engineering. This re-design, and later ones now current, led to a very great advance in performance and economy over Calder Hall. The various factors responsible for the improvement are discussed, including increases in the diameter and working pressure, and improved internal geometry of the main pressure vessel; increased rating and temperature of the fuel and new heat transfer surfaces for the fuel elements. Modifications to the design which have arisen from consideration of postulated fault conditions, and the development of major components such as main gas valves and bellows are considered. Work is reported on the leak tightness of the Calder Hall pressure circuit, and on the principles of design to be applied to similar circuits. (auth)

7206 A/CONF.15/P/74
HUNTERSTON POWER STATION. R. N. Millar (General Electric Co., Ltd., Erith, Kent, Eng.). 29p.

The research work necessary to enable new requirements for the Hunterston power station to be met is outlined, and a brief general description of the station is given. Components and techniques described include reactor vessel and core, fuel handling, reactor servicing machine, steam raising units, gas circuits, control and instrumentation, fuel elements, and generating plant. Operation costs are assessed, and the influence of the fuel cycle on power costs is discussed. Nuclear and design data are given. (W.D.M.)

7207 A/CONF.15/P/83
THE KINETICS OF PRESSURISED WATER AND OTHER REACTOR POWER PLANTS. A. Birch (Rolls-Royce Ltd., Derby, Eng.). 16p.

Analog computer studies of typical pressurized-water-reactor power plants using water as moderator and coolant are discussed. The aim is to present in generalized form information about the dynamic behavior of the plant and possible control system. A brief discussion of the analog computing techniques used and the degree of refinement necessary in the mathematical models of the simulated plant is given. It is shown that the methods involved may be extended to other reactor power plants. The steady-state relationships between power and temperature in the plant are examined, and it is shown that operation at a constant mean coolant temperature is desirable. (auth)

7208 A/CONF.15/P/85
THE OVERALL CONTROL OF NUCLEAR POWER STATIONS OF THE GAS-COOLED THERMAL REACTOR TYPE. R. J. Smith (General Electric Co. Ltd., Erith, Kent, Eng.). 32p.

The location of control facilities is briefly discussed, and basic operational requirements are reviewed. The influence of the plant on part-load operating conditions and permissible transient performance is emphasized, and typical part-load characteristics are quoted. In a section on the main control elements, the choice of coolant circulator systems is discussed in some detail. Requirements to ensure trip-free operation and safe control apparatus are listed, and power cut-back advocated. Typical automatic control arrangements are analyzed. (auth)

7209 A/CONF.15/P/86
BURNABLE POISONS IN SMALL POWER REACTORS. A. M. Smith and J. Jeffrey (Rolls-Royce Ltd., Derby, Eng.). 11p.

In the design of small reactors suitable for propulsion purposes the need for a large amount of excess reactivity to compensate for the effects of depletion and fission product poisoning leads to a difficult engineering problem in the accommodation of an adequate amount of control rods to shut the reactor down. Moreover, unless a complex control rod program is used, very distorted flux distributions can arise, leading to very high temperatures in the core. The use of a burnable poison can help in both of these difficulties. An analysis of the physics aspects of the inclusion of burnable poisons in a reactor is presented for a simple model of the core, and figures are given for the case of a light water cooled and moderated reactor. For example, it is shown how such a reactor, designed to run for 1,000 equivalent full power hours with full xenon override, can, by the use of a burnable poison, have its fuel loading increased so that its life is extended to about four times this figure. It is also shown how under certain

circumstances the addition of a burnable poison to a reactor can shorten its life. (auth)

7210 A/CONF.15/P/136
ADAM—A 75 MW NUCLEAR ENERGY PLANT FOR HOUSE HEATING PURPOSES. I. Wivstad (Swedish State Power Board, Stockholm) and C. Mileikowsky (ASEA, Västerås, Sweden). 37p.

For some years the Swedish State Power Board has been supplying heat to the town of Västerås from a district heating plant. The increase in the demand for heat will be met by the construction of a reactor plant of 75 Mw nominal output. On account of the earlier supply the utilization time of the plant will exceed 5000 hours annually. It is to be built underground. The fuel elements are designed as clusters, each cluster a number of cylindrical fuel element rods. Each rod is a finned aluminum tube containing sintered oxide pellets. The filling gas is helium, coolant, moderator, and reflector are heavy water, forming one common water system, moderator and coolant, being in series in the circuit. This system has made possible a simple design and is advantageous in several ways from a safety point of view. The temperature of the coolant leaving the reactor being only 140°C, a pressure vessel design has been adopted which is also specially convenient for the moderator-coolant system. The fuel elements are changed through the top of the reactor. The coarse control and shut down are performed by control rods. These move into the reactor core from above inside the pressure vessel and are cooled by the moderator water. (auth)

7211 A/CONF.15/P/155
SUITABLE TYPES OF REACTORS FOR THE DEVELOPMENT OF NUCLEAR POWER SUPPLY BASED ON NATURAL URANIUM AS FUEL. D. Jungnell and S. Lundquist (Swedish State Power Board, Stockholm.) 36p.

The connection between the production and consumption of Pu in various types of reactors, conditions for being able to provide the required output from breeder reactors alone, and the most favorable distribution of nuclear power among the various types with respect to the U consumption is presented. A number of technical factors are involved, the most important of them being the possible fuel burnup, the required amount of Pu per unit of power for the various types of reactors, the breeding gain in the case of the breeder reactor, the rate of increase of the load, and the costs for the fuel fabrication and recycling. The effect of these factors on the choice of reactors and on economic aspects is discussed. (W.L.H.)

7212 A/CONF.15/P/172
ON THE DESIGN AND CONTAINMENT OF NUCLEAR POWER STATIONS LOCATED IN ROCK. L. Carlbom and H. von Ubisch (AB Atomenergi, Stockholm); and C.-E. Holmquist and S. Hultgren (Swedish State Power Board, Stockholm). 14p.

The differences in properties in underground structures and enclosures of a steel shell type are outlined. The advantages to be gained by building underground are discussed. An outlay of an underground station design and an estimation of the costs as compared to a station at ground level are given. (W.D.M.)

7213 A/CONF.15/P/183
CANADA'S STEPS TOWARDS NUCLEAR POWER. W. B. Lewis (Atomic Energy of Canada Ltd., Chalk River, Ont.). 11p. (AECL-593). $0.25(AECL).

The status of the program for economic nuclear power in Canada is reviewed. The program begins with a 20 Mw(e) demonstration plant now well advanced in design and will result in a heavy water moderated 200 Mw(e) natural uranium reactor. The relation of the various Canadian papers to the over-all power program is shown. (W.D.M.)

7214 A/CONF.15/P/208
A STUDY OF A FULL-SCALE, URANIUM AND HEAVY WATER NUCLEAR POWER PLANT. H. A. Smith Hydro-Electric Power Commission of Ontario, Toronto), W. M. Walker and N. L. Williams (British Columbia Electric Co. Ltd., Vancouver, Can.); and E. Critoph (Atomic Energy of Canada Ltd., Chalk River, Ont.). 32p. (AECL-618.) $0.25(AECL).

The proposed full-scale plant is moderated and cooled with heavy water and is fueled with natural uranium oxide. The fuel and high-pressure coolant (70 atmospheres) are contained in horizontal pressure tubes made of Zircaloy-2. The moderator at 80°C and under virtually atmospheric pressure is held in a horizontal cylindrical tank made of aluminum. A simple fueling system permits a burn-up of 8,000 Mwd/t without processing or the recycling of plutonium. The fuel is made of short assemblies of round rods of uranium oxide. These assemblies are placed in one end of the reactor and are progressively moved through the reactor until they reach their full irradiation. To reduce flux distortion, alternate channels are fueled from opposite ends of the reactor. This requirement is most easily met if the fuel channels are horizontal. Because the reactor will operate at the poison limit of fuel burnup, it is proposed to change fuel under power. The daily fuel requirement at 100% load is eight sections of fuel each 30 cm long. The reactor will have a natural water reflector around the tank and at the ends. (auth)

7215 A/CONF.15/P/209
THE CANADIAN NPD-2 NUCLEAR POWER STATION. I. N. MacKay (Canadian General Electric Co. Ltd., Peterborough, Ont.). 19p. (AECL-619). $0.25(AECL).

The station will have a net electrical output of about 20 Mw. The reactor uses natural uranium fuel in the form of sintered dioxide, with heavy water as the moderator. It is arranged with horizontal tubes of zirconium alloy containing the fuel and pressurized heavy water coolant. The reactor vessel is of aluminum alloy and contains the moderator at substantially atmospheric pressure; the space between its double walls contains natural water as a neutron reflector and shield. Coolant leaves the reactor at 277°C and about 70 atmospheres and passes through the heat exchanger where its temperature is reduced to 252°C. Dry, saturated steam is generated at 30 atmospheres. The coolant is circulated by three vertical shaft-sealed pumps with conventional motors. The pumps are fitted with flywheels to prevent boiling of the coolant immediately following a power failure. (auth)

7216 A/CONF.15/P/240
THE MANUFACTURE OF INTERNALLY COOLED PRESSURIZED-TUBE ELEMENTS OF METALLIC URANIUM BY A ZONE MELTING PROCESS. E. Bodmer, P. de Haller, and P. Sulzer (Sulzer Brothers Ltd., Winterthur, Switzerland). 12p.

Zone melting permits the manufacture of pressurized-tube elements with simple equipment. Previously cast uranium cylinders are fitted over tubes of Zircaloy-2.

It is possible to insert drilled plates of graphite between the uranium cylinders. These help to prevent segregation (in the case of uranium alloys) during the zone melting process and later, when the reactor is in service, are able to cushion the swelling of the uranium to a certain extent. The element thus constituted is encased in a suitable permanent mold and is then subjected, under vacuum conditions, to an inductive zone melting process from bottom to top. The rate of feed and the inductive input are so regulated that the uranium, as the molten phase, is welded to the Zircaloy-2 in the shortest possible time. The fuel element thus produced has the cast uranium structure which has been recognized as advantageous. The metallic bond between uranium and Zircaloy-2 is in no way inferior in mechanical properties and resistance to corrosion to the bonds obtained by other methods. (auth)

7217 A/CONF.15/P/252
LA CENTRALE EXPERIMENTALE D'ENERGIE NUCLEAIRE S. A. (The S. A. Experimental Nuclear Energy Power Station.) M. Cuénod (Société Générale pour l'Industrie, Geneva); A. Gardel (Bureau Bonnard & Gardel, Lausanne, Switzerland); G. Psarofaghis (S. A. des Ateliers de Sécheron, Geneva); and P. Ribaux (Ateliers des Charmilles S. A., Geneva). 19p.

The design of an experimental nuclear power station to be constructed in Switzerland is described. The reactor will be a boiling water type using slightly enriched uranium oxide as fuel and light water as moderator and coolant. The characteristics of the reactor are given. The reasons for the choice of a boiling water reactor are discussed. The various circuits of the power plant are briefly described. The power plant will consist of the subterranean part and the exterior building and installations; the construction of each is described. The energy and operating costs are briefly considered. (J.S.R.)

7218 A/CONF.15/P/259
DIPHENYL COOLED, HEAVY WATER MODERATED, NATURAL URANIUM REACTOR PROTOTYPE. W. Hälg and Th. Schaub (Reaktor A.G., Würenlingen, Switzerland). 39p.

This paper was previously abstracted as RAG-4 in NSA 13-961.

7219 A/CONF.15/P/263
BRADWELL NUCLEAR POWER STATION. R. D. Vaughan and E. Anderson (Nuclear Power Plant Co., Ltd., Knutsford, Eng.). 34p.

Descriptions of the site, reactor, and auxiliaries of the Bradwell nuclear power station are presented. Theoretical and physical features of the core are explained with particular reference to the advanced type of fuel element developed especially for this design. The boilers, gas circuits, and reactor vessel are described along with the control system and turbogenerator section of the plant. (W.D.M.)

7220 A/CONF.15/P/264
THE BERKELEY POWER STATION. S. A. Ghalib and J. R. M. Southwood (John Thompson Nuclear Energy Co. Ltd., Knutsford, Ches., Eng.). 43p.

The major design features of the Berkeley Power Station are described, and the considerations leading to their choice are discussed. Detailed descriptions are given for the various reactor components, and the operational characteristics are discussed. (W.D.M.)

7221 A/CONF.15/P/265
NUCLEAR PROPULSION FOR MERCHANT SHIPS. S. L. Smith and J. E. Richards (British Shipbuilding Research Assn., London). 15p.

Views arising from the British Shipbuilding Research Association studies on the possible application of nuclear propulsion to merchant ships are presented. The capital cost of nuclear reactors is much higher than that of oil-fired boilers and for this and other reasons the first commercial application of nuclear power will possibly be to a large oil tanker. In order to assess the relative importance of direct fuel cost, capital cost, and machinery weight the results of an economic study of tanker operation are given. The question as to whether the economic speed of large tankers would be increased by the adoption of nuclear propulsion is discussed. Various types of reactors are compared. (W.D.M.)

7222 A/CONF.15/P/266
NUCLEAR PROPULSION FOR SHIPS. R. V. Moore and C. E. Iliffe (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). 21p.

The requirement of low weight per shaft horse power for marine plant and the means by which this may be attained are discussed. The fuel economy of small reactors and the way in which this can be maximized to provide a low fuel cost is then examined. By way of illustration, it is shown that a carbon dioxide/graphite thermal reactor might be designed as a marine unit. This involves using enriched fuel at a high rating. The problems involved are enumerated and discussed. The economic performance of such a unit driving a supertanker is compared with a conventional ship of the same deadweight capacity. It is shown that the operating costs of the nuclear vessel will be 10 to 15% higher than for the conventional one. The marine application raises many new problems in relation to health and safety, which must be resolved before nuclear propulsion can be exploited on a large scale. Some of these problems are discussed. It is concluded that, in spite of the success of nuclear propulsion units for special purposes, notably submarine propulsion, their widespread use, particularly for vessels requiring propulsion units less than about 25,000 s.h.p., lies somewhat in the future. (auth)

7223 A/CONF.15/P/267
SAFETY ASPECTS OF THE CALDER HALL REACTOR IN THEORY AND EXPERIMENT. G. Brown, H. Kronberger, F. M. Leslie, and J. Moore (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.) and P. W. Mummery (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 39p.

The design specification, construction requirements, and inspection which ensure the soundness of the reactors at Calder Hall and similar power stations are discussed. The nuclear and thermal kinetics of these natural uranium gas-cooled graphite-moderated reactors are examined, and an account is given of relevant experiments, including those carried out on the Calder Hall reactors. This work takes into account the presence of plutonium and the consequent increase in moderator temperature coefficient with irradiation level. An outline is given of the results of compatibility studies and of the effect of irradiation on fuel elements, on graphite (with particular reference to stored energy), and on constructional steels. In the light of the information obtained on the nuclear and thermal character-

istics of the reactor, a number of hypothetical fault conditions are examined. These include loss of reactivity control, blower failure, and loss of pressure. (auth)

7224 A/CONF.15/P/273
STEAM CYCLES FOR GAS-COOLED REACTORS. W. R. Wootton, A. J. Taylor, and N. G. Worley (Babcock and Wilcox, Ltd., London). 21p.

The potentialities of the steam cycle in association with possible trends in nuclear reactor development are investigated. Attention is confined to gas cooled reactors and emphasis is placed on the most probable coolant temperatures entering the reactor and those likely to be attained in the future at the reactor outlet. The coolant temperature leaving the reactor is assumed to progress in increment of 50°C in the course of time from 350 to 600°C and the most probable steam cycles are found for each stage of development. These lead to an indication of the trend of efficiency of future nuclear steam power plants of the gas-cooled type. (W.D.M.)

7225 A/CONF.15/P/274
THE DOUNREAY FAST REACTOR—BASIC PROBLEMS IN DESIGN. H. Cartwright, J. Tatlock, and R. R. Matthews (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). 21p.

The engineering design of the Dounreay Fast Reactor is reviewed. The basic problems inherent in a small highly-rated system are considered in the light of fundamental principles adopted at the outset. The reactor features are discussed in relation to the core, control system, primary coolant system, liquid metal to water heat exchangers, and multi-circuits for heat rejection. (auth)

7226 A/CONF.15/P/301
SOME EXPERIENCES IN THE INDUSTRIAL GROUP OF THE U. K. ATOMIC ENERGY AUTHORITY, 1947–1958. Leonard Owen (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). 13p.

The program which resulted in the production of nuclear power in Great Britain is reviewed. (C.H.)

7227 A/CONF.15/P/310
A MONTE CARLO STUDY OF THERMAL UTILIZATION FACTOR AND DIFFUSION AREA: GAS-COOLED GRAPHITE-MODERATED LATTICES. G. W. Schaefer and D. M. Parkyn (English Electric Co., Ltd., Whetstone, Leics, Eng.). 16p.

An attempt is made to explain the results from thermal flux in gas-cooled graphite-moderated uranium lattices experiments by solving the one-energy-group transport equation by the Monte Carlo method, using fundamental cross sections. The experiments of Campbell et al. and the theory of Amouyal et al. are compared with the Monte Carlo results. A survey of diffusion areas and asymmetries was carried out, using a number of mathematical models. The results are compared with theory and experiment. The survey is restricted to cylindrical fuel rods in circular channels and square pitches. (W.D.M.)

7228 A/CONF.15/P/311
THEORETICAL ASPECTS OF FUEL CYCLING IN INDUSTRIAL CALDER HALL TYPE REACTORS. S. E. Lewis (Nuclear Power Plant Co., Ltd., Knutsford, Ches, Eng.) and C. S. Lowthian (AEI-John Thompson Nuclear Energy Co., Ltd., Knutsford, Ches., Eng.). 23p.

A basic theory of once-through fuel cycles is developed, which considers the variation of reactivity with fuel irradiation. It is shown how values of the fuel life can be obtained for various simple cycles and how these lives are a function of the reactivity which is allocated to life rather than to reactor heat output. The effect of the allocation of reactivity on the total generation cost of electricity is discussed. The concept of an equilibrium state is considered, in which the fuel cycle is so arranged that the over-all reactivity of the reactor does not vary with further irradiation. The reactivity at any specific point within the reactor is, however, a function of the fuel cycle adopted and it is shown how the resultant perturbations of the flux and specific heat production can be determined. In the approach to the equilibrium state for a reactor loaded with new fuel, a modified fuel cycle can be adopted, in which the fuel is charged at different rates. The conditions for the optimum degree of delayed onset of cycling are established and the effects on the reactivity discussed. (auth)

7229 A/CONF.15/P/312
ADVANCES IN THE DESIGN OF GAS-COOLED GRAPHITE-MODERATED POWER REACTORS. R. V. Moore, H. Kronberger, and L. Grainger (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). Includes Addendum 1. 23p.

The main engineering features and economic performance of reactors of the improved Calder Hall type, fuelled with natural uranium, are considered. The effect of higher fuel rating on design is discussed; this involves the segregation of the fuel into forms with large surface-to-volume ratios, and the use of slight enrichment. Fuel cycles in relation to this requirement are described. Fuel elements of new materials, in which the present temperature limitation is removed, are under development. It is intended that these will be exploited in the design of British nuclear power stations coming into commission around 1965. The improved performances of these power stations is estimated, and it is shown that the much reduced capital cost per kilowatt will lead to reduced unit cost, even at the lower load factors expected as the use of nuclear power becomes more widespread. Fuel cost can be reduced by the development of fuel elements which will sustain longer burn up. Fissile material in a ceramic form appears to have higher irradiation stability than the metals. These developments, together with the metallurgical development of high temperature canning materials, are discussed. Problems related to the stability and life of the moderator and the safe operation of a highly-rated reactor with plutonium-rich fuel are discussed in detail. (auth)

7230 A/CONF.15/P/314
THE POSSIBILITIES OF ACHIEVING HIGH TEMPERATURES IN A GAS COOLED REACTOR. L. R. Shepherd, R. A. U. Huddle, L. A. Husain, G. E. Lockett, F. Sterry, and D. V. Wordsworth (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 36p.

Large natural uranium gas cooled power reactors have limitations with regard to core heat output density, which implies that they must be relatively cumbersome. They are also limited in maximum attainable coolant outlet temperature. There is an obvious incentive to develop compact reactors having core power densities as high as pressurised water reactors, but not possessing the coolant temperature limitations either of pressurized water reactors or of the more advanced natural

uranium gas cooled systems. Coolant outlet temperatures in excess of 650°C are needed in order to exploit the most modern steam turbine generating equipment. A higher outlet temperature of 750°C is desirable for gas turbine application or for a mixed steam/gas turbine system. Some thought is being given to the possibility of a high temperature gas cooled reactor in which an enriched fuel is incorporated in a solid moderator to give fuel elements of greatly extended heat transfer surface area, thereby permitting a high density of heat output from the core. The core materials are in a highly refractory form (e.g., graphite and ceramics) and metal fuel element sheaths are avoided. These materials will be allowed to run to much greater temperatures than have been possible in metal fuel elements and, as a result, high gas temperatures can be obtained. (auth)

7231 A/CONF.15/P/315
REACTOR PHYSICS MEASUREMENTS DURING THE COMMISSIONING OF THE CALDER REACTORS. F. M. Leslie (United Kingdom Atomic Energy Authority, Sellafield, Cumb., Eng.). 11p.

Details of some of the measurements made during the commissioning and early operation of the Calder reactors are presented. The measurements include critical size, lattice constants, control rod calibration, xenon poisoning, temperature coefficients, and reactivity build-up. Brief mention is made of future experimental work on control rods and temperature coefficients. (auth)

7232 A/CONF.15/P/317
DEVELOPMENT OF MANUFACTURING TECHNIQUES FOR THE CALDER HALL FUEL ELEMENT. F. Butler, J. Harper, I. H. Morrison, and J. A. Pardoe (United Kingdom Atomic Energy Authority, [Risley, Lancs, Eng.]). 14p.

A general description of the cartridge is given with an indication of the stages leading up to its production, including feasibility studies, technical development, and a prototype production line. The cartridge is described, together with the method of manufacture and heat treatment of the uranium bar and the factors which led to the route selected. Conditions which gave rise to the design of can are traced and the methods of manufacture reviewed. In particular, stress is laid on the advance in fabrication of magnesium alloys which canning demands have promoted. Methods of locking to check ratchetting are discussed, and development work aimed at improved versions of the cartridge is described. The philosophy which led to the design of closure selected is given, as well as the reasons for choosing a particular welding technique for the final seal. Testing methods and helium filling are described. (auth)

7233 A/CONF.15/P/492
PACKED BED FUEL ASSEMBLY FOR A GAS COOLED HETEROGENEOUS REACTOR. Milorad Ristić and Zoran Zarić (Inst. of Nuclear Sciences "Boris Kidric," Belgrade). 6p.

In a gas-cooled heterogeneous reactor the film heat transfer coefficient is low, due to a reasonable pumping power, thus leading to large temperature gradients and thermal stresses in the fuel. From the point of view of a maximum permissible temperature in fuel, there is an upper limit for the exit gas temperature. With the conception of a packed-bed fuel element, which has a better surface-to-volume ratio resulting in a smaller temperature gradient in the fuel, there exists the possibility of improving this situation. A new conception of the fuel element as being a packed bed in the center of a cylindrical channel through and around which cooling gas is flowing axially is discussed. This conception is compared with another one with several fuel rods of small diameter, placed axially in the channel. The comparison shows that the packed-bed fuel element has certain advantages. Thus, for the same pumping power, the same maximum temperature in fuel, and the same heat generation per unit volume, with a packed bed fuel element one obtains a higher temperature gradient along the cooling channel. (auth)

7234 A/CONF.15/P/561
UNDERGROUND LOCATION OF A NUCLEAR REACTOR. N. G. Aamodt (Joint Establishment for Nuclear Energy Research, Kjeller, Norway). 22p.

A description of the civil engineering of the Halden reactor plant is given. Special design and constructional problems are discussed, based on experience from the erection of the plant. A technical economical comparison of the "rock housing" for the Halden reactor buildings of normal and gas-tight construction is also given. (A.C.)

7235 A/CONF.15/P/961
BREEDING AND CONVERSION PROCESSES IN HIGH-TEMPERATURE REACTORS. H. Wundt (Brown, Boveri & Cie. AG., Mannheim, Ger. and Fried. Krupp, Mannheim, Ger.). 39p.

The reactor design considered is a one-region reactor containing only fissile and fertile materials besides the graphite moderator and reflector. Since the maximum enrichment available to most countries is 20%, the conversion process involves both U^{233} and Pu^{239}. The two initial moderating ratios of the fertile materials are taken as independent parameters, and for 60 combinations of these the time behavior of k_∞ is worked out which shows the most desirable charging schedule for new fuel and possible burnup times. (W.D.M.)

7236 A/CONF.15/P/1005
FUEL ELEMENTS FOR A HIGH-TEMPERATURE REACTOR. A. Boettcher and G. Wirths (Degussa, Frankfurt a.M.); and R. Schulten (BBC, Mannheim, Ger.). 5p.

Fuel elements for a high-temperature inert-gas-cooled reactor are described. Requirements include high mechanical strength, 1100°C surface temperature, resistance to sudden thermal change, and ease of charging and discharging. The fuel elements consist of spherical graphite bodies with a diameter of 5 to 6 cm and a borehole into which the fuel is inserted. The borehole is tightly sealed off by a graphite plug. (W.D.M.)

7237 A/CONF.15/P/1054
THE PEBBLE-BED HIGH-TEMPERATURE REACTOR FOR 15 MW (ELECTR.). R. Schulten (Brown, Boveri & Cie. AG. and Fried. Krupp, Ger.). 15p.

The problems concerning the construction of a gas-cooled high-temperature reactor are presented. The behavior of the reactor within the temperature range of 600 to 1000°C and pressure range of 1 to 10 kg per square centimeter absolute is discussed along with suitability of various gases as heat transfer media, behavior of fuel elements, and diffusion of fission products. (W.L.H.)

7238 A/CONF 15/P/1095
STATISTICAL ASPECTS OF THE KINETICS OF A CIRCULATING LIQUID METAL FUEL SUSPENSION

REACTOR. J. J. Thompson (Atomic Energy Commission, Australia). 16p.

Estimation of the response of a nuclear reactor operating at power to fluctuations in the fuel concentration in a liquid metal suspension used as fuel carrier and heat removal medium is discussed. The particular example is micron size particles of uranium metal in liquid sodium circulating through a beryllium moderator. The fluctuations are assumed random, and the mean square neutron density, power, and temperature fluctuations are given by the integrals of the appropriate spectral densities which are derived from the transfer functions of the reactor in terms of the mean fuel channel inlet concentrations. A uniform reactor is considered in detail, the basic functions being given explicitly, and calculations are reported for the particular system which has statistically similar but independent mean inlet fluctuations, whose autocorrelation function is assumed to be obtained from a Poisson distribution of concentration changes. The results obtained are of a general nature owing to lack of experimental observations on the fuel concentration fluctuations in a dilute suspension of heavy particles to be expected at the inlet to a reactor core, and the very large number of reactor parameters involved. (auth)

7239 A/CONF.15/P/1131
ATOMIC ENERGY AND THE FRENCH PROBLEM OF ENERGY SUPPLIES. Pierre Ailleret (Electricité de France, Paris). 15p.

The role of nuclear power plants in the over-all power program in France is considered. It is pointed out that it is now too early to predict the optimum time for the switch to nuclear power. Cost factors are still uncertain. The possibility of the development of fission and other potential power sources is considered. In the present phase of nuclear power development the main purpose of reactors is to yield experience and not to generate power. It is anticipated that power output will increase as experience is gained and technological progress is made. The impact on industry of a sudden switch from conventional to nuclear power is considered. (C.H.)

7240 A/CONF.15/P/1132
EXPERIENCE ACQUIRED DURING TWO YEARS OF OPERATION OF REACTOR G 1. de Rouville, Pascal (Commissariat à l'Energie Atomique, Paris); and Scalliet (Electricite de France, Paris). 16p.

On the 7th of January 1956 the G-1 reactor started up for the first time. Several experiments to define most of its operating data were conducted. It was found that suitable neutron flattening can be obtained from a mixed array which is composed of 2.556 uranium elements and 104 thorium elements, and the parameter limiting the power in the fuel element cans is the temperature. Several operating conditions from 30 to 40 Mw were tried. In addition, emergency cooling flows were defined. Other information gained from the operation included the following: fine adjustment of graphite reheating system brought about considerable difficulties in provision against the Wigner effect; the premature shutdowns owing to bad handling, unsuitable operations of control circuits and feed, and burst slugs are now clearly in regression; and the reactor is self regulated and very easy to operate. Numerous experimental tests have revealed the agreement of data given by the different measurements of temperature. Apart from the burnt element, about ten burst slugs were detected in the last two years. None of them had prolonged results, usually stopping the reactor for about 1 or 2 hours. The optical examination of every unloaded element revealed that the fitting margins were more important than the swellings. The permissible burnup levels have not been reached. The magnesium canning was more resistant than expected to corrosion, especially to steam. On the 28th of September, the energy recovering plant and the G-1 reactor were both linked onto the line for the first time. The adjustment of the recovered power is obtained with no difficulty and with remarkable stability only by adding water to head boiler. The heat regenerator has not had to bear any event. It means that the danger due to corrosion is not so important as foreseen. (auth)

7241 A/CONF.15/P/1133
GENERAL SPECIFICATIONS AND ORIGINAL ASPECTS OF REACTORS G2 AND G3. Pascal, [J.] Horowitz, [J.] Bussac, Joatton, de Lagge de Meux, and Martin (Commissariat à l'Énergie Atomique, Paris). 15p.

The objectives of G2 and G3 were the production of plutonium along with a significant amount of electricity. The initial specifications were chosen as a direct result of experience gained from G1 and EL2. The essential requirements were to maintain the pressure of the cooling gas slightly above that of the steam, the loading and unloading of fuel under pressure and operation, horizontal arrangement for the fuel elements, and prestressed concrete for the pressure vessel. The prestressed concrete allowed for a high operating pressure and improved performance. (W.D.M.)

7242 A/CONF.15/P/1134
DESCRIPTION OF REACTORS G-2–G3. (France-Atome.) 50p.

The reactor core includes most of G-1 reactor parts including horizontal channels, graphite parallelepipedic bricks stacking, and steel thermal shield. The cooling is provided with CO_2 under a 15 atmospheres pressure. This pressure is kept steady in a press-stressed concrete packing-case in the form of a horizontally shaped cylinder. Packing-case tightness is provided by a 30 mm iron plate connected with the inner wall of concrete. One of the reactor's special characteristics is the possibility of loading and unloading while operating. On the loading side, barrel-locks, each weighing 50 tons, allow new cans, at a pressure of 15 atmospheres, to pass. The cans process almost in a steady way through the channel, and finally drop down through bent spouts, then through spiral toboggans into a new lock. The cooling CO_2 flow is provided with 3 turbo-bellows; these are actuated by average pressure steam, obtained from exchangers. Every reactor supplies 4 exchangers. The secondary cycle is standard and contains 3 stages. Steam can be condensed in the event of a group turbo-generator stopping, with no modification for the normal operating conditions of the reactor. Auxiliary circuits have to assure the continuous purifying of cooling CO_2, its storage, and drain. Forty-nine boron carbide rods are used to control the operating power levels of reactor. The regulating system has brought about difficult problems; however, experimental examination, while operating, will solve them. (auth)

7243 A/CONF.15/P/1135
THE CHINON NUCLEAR POWER PLANT DIVISIONS EDF 1 AND EDF 2. M. Roux and M. Bienvenu (Electricité de France, Paris). 100p.

The characteristics and the over-all plan of the EDF-1 and -2 plants are described. The construction and work

programs are reviewed. Both plants are natural uranium graphite reactors cooled by CO_2 under 355 lb/in.^{2} pressure. The EDF-1 is a 82 Mwe plant using 140 tons of U with the steam pressure lower than the CO_2 pressure. The EDF-2 is a 200 Mwe plant using 250 tons of natural U with the steam pressure everywhere greater than the CO_2 pressure. (W.D.M.)

7244 A/CONF.15/P/1135 (Add. 1)
THE CHINON NUCLEAR POWER PLANT, DIVISIONS EDF 1 AND EDF 2. M. Roux and M. Bienvenu (Electricité de France, Paris). 29p.

Illustrations and figures are presented that were omitted from the English text of the report. (W.D.M.)

7245 A/CONF.15/P/1137
POSSIBILITIES AND CONDITIONS OF USE OF WATER OR GAS TYPE REACTORS IN A TANKER. I. PRESSURIZED WATER REACTOR. L. Bureau du Colombier, J. Hainzelin, and P. Duquesne (Chantiers de l'Atlantiques, Paris). II. BOILING WATER REACTOR. J. Ricard and P. Domenjoud (Société des Forges et Ateliers du Creusot, Paris). III. GAS REACTOR. R. Gibrat (Société Indatom, France). 79p.

The French Atomic Energy Commission and the Secretary of State for the Merchant Navy have organized a study for the design of a nuclear-propelled oil tanker of 40,000 tons and 20,000 hp maximum power. Three types of reactors were considered: gas cooled, pressurized water, and boiling water. This report, issued from the study, shows the characteristics and difficulties peculiar to each of these solutions and describes a number of particular dispositions permitting the installation of such reactors on board ship. (auth)

7246 A/CONF.15/P/1145
THERMAL EXCHANGES IN GAS REACTORS. J. Le Foll, P. Gelin, and E. De Robert (Commissariat à l'Énergie Atomique, Paris). 51p.

Both convection and conduction come into play simultaneously in the transfer of the heat from the fuel to the gas, and these two phenomena are quite different, both as to their nature and as to the present knowledge of the laws which apply to them. An endeavor is made to distinguish between these two phenomena to the fullest possible extent in order to restrict the experimentation to an investigation of forced convection and to the indispensable over-all verifications. (W.D.M.)

7247 A/CONF.15/P/1157
THE FUEL ELEMENTS IN PRESSURIZED GAS REACTORS. J. A. Stohr, M. Englander, and M. Gauthron (Commissariat à l'Énergie Atomique, Paris). 74p.

Various cladding materials and processes and natural uranium base fuels were investigated for use in CO_2 cooled reactors. Tests used in connection with the fuel element study are described. The processing of the Saclay EL-2 fuel elements are described, from the vacuum casting of the raw billet to the inspection tests prior to loading into the pile. The operational results of the first set of fuel elements that have been used in EL-2 are outlined, together with a description of the few incidents which have occurred during operation. Fuel elements for the reactors now in the building stage are described, and the change in design discussed. (W.D.M.)

7248 A/CONF.15/P/1180
PARTIAL COMBUSTION OF A FUEL CARTRIDGE IN REACTOR G1. de Rouville, Leduc, and Segot (Commissariat à l'Énergie Atomique, Paris). 7p.

An event which took place on October 26, 1956, at the very beginning of the power operation of the G-1 reactor at Marcoule is described. One of the magnesium-clad uranium fuel cartridges developed a jacket leak and partial burning of the magnesium took place. The work of clearing the channel is described. No definite cause for the accident could be assigned but it was concluded that an event of this sort is not dangerous to the reactor or to personnel. The main characteristics of the jacket-leak detection device are given. (W.D.M.)

7249 A/CONF.15/P/1191
NATURAL URANIUM–GRAPHITE SYSTEM. A. P. Schmitt, P. Tanguy, A. Teste du Bailler, and C. P. Zaleski (Commissariat à l'Énergie Atomique, Paris). 20p.

The period of preliminary tests, while the Marcoule G-1 reactor was being put into service, was used to carry out several neutron physics experiments. These experiments, including neutron diffusion length in graphite, effect of thorium contamination, criticality studies, flux distributions, etc., are described. (W.D.M.)

7250 A/CONF.15/P/1195
ETUDE DE LA REGULATION D'UNE INSTALLATION ATOMIQUE PRODUCTRICE D'ENERGIE. (Study of the Regulation of an Atomic Installation for the Production of Energy.) R. Dautray and J. C. Leny (Commissariat à l'Énergie Atomique, Paris). 58p.

The regulation of a nuclear power station is studied. The natural U reactor is cooled and moderated with separate pressurized heavy water circuits. The coolant removes the reactor heat to a heavy water–light water heat exchanger. Two plans were studied: in the first the light water is first heated by the moderator and in the second the heating of the light water is suppressed. Models are made for studying slow and fast phenomena, and the two models are synthesized into a third to study slow and fast phenomena together. The temperature of the moderator in the reactor is studied as a function of the position and time. Small changes of power and the transfer functions of the system are investigated. A regulation scheme for the power plant is then established. A general stability study of the plant for any fixed power level is included. (J.S.R.)

7251 A/CONF.15/P/1196
POSSIBILITIES ET LIMITATIONS DU CALCUL ANALOGIQUE POUR LES ETUDES DYNAMIQUES DE CENTRALES NUCLEAIRES. (Possibilities and Limitations of Analogue Methods for Studying the Dynamics of Nuclear Power Stations.) Claude Caillet and Max Deat (Commissariat à l'Énergie Atomique, Paris). 46p.

The analog simulation of nuclear reactor problems except for the simulation of the kinetic equations is discussed. Various problems relative to temperature in a reactor, pipe, exchanger, and turbine are studied, and simulation techniques used by earlier workers are critically reviewed. It is shown the problem of pipe simulators can be solved by the use of specialized simulators which are described. The aspects of rotating machine simulators are discussed, and a simulator requiring both digital and analog methods is described. The thermodynamic problems of nuclear power stations are considered, and an example is given. (J.S.R.)

7252 A/CONF.15/P/1199
VESSEL AND HEAT EXCHANGER OF THE E.D.F.1

CHINON POWER PLANT. Lamiral and Lancel (Electricité de France, Paris). 28p.

The 4.2 in. thick steel pressure vessel for the gas-cooled EDF-1 is described. The dimensions of the pressure vessel (cylinder with hemispherical ends 33 ft diameter, 76 ft high) were fixed by the volume of the active core and its reflector. In view of the characteristics of the CO_2 (140°C inlet 355°C outlet) the number of vaporization stages for the heat exchanger was fixed at two. The steam pressure is kept below that of the CO_2. The multiple exchanger consists of 120 cylindrical elements of 24 in. diameter and 9.2 ft high. (W.D.M.)

7253 A/CONF.15/P/1200
LA REGULATION DE LA CENTRALE NUCLEAIRE E D F. 1. (Control of the EDF.1 Power Plant). Deloux and Laurent (Electricité de France, Paris). 21p.

The EDF.1 nuclear power plant was designed to supply the French general network with electrical energy. It operates, as a rule, at full power, but it was designed to be as versatile as a classical steam plant. This consideration imposes the use of an automatic control system to assure its correct functioning in normal operation, the utilization of automatic sequences to reduce the charge, and the placing in service of auxiliaries in the case of an incident. A survey is given of the way in which the problem is presented, the means used to study the problem, and the results obtained with respect to the control system adopted and the operations to provide for conditions created by incidents. (J.S.R.)

7254 A/CONF.15/P/1201
LES PROBLEMES DU CHARGEMENT ET DECHARGEMENT DES ELEMENTS COMBUSTIBLES DANS LE REACTEUR E.D.F.1. (Loading and Unloading Problems for the Reactor E.D.F.1). Leo, Kaplan, and Segard (Electricité de France, Paris). 25p.

The EDF-1 reactor has two loading and unloading devices of completely different design. The main device, which operates when the reactor is shut down and the pressure vessel is under pressure, is the lower unloading system and it has a single arm which serves all the channels. The description of the lower system, its operation, and the details of its use are given. The upper unloading device, designed to operate when the reactor is shut down and the pressure vessel is without pressure, is used when the lower device fails. The loading and unloading is performed through the control rod holes. A detailed description is given of the upper device and its operation. (J.S.R.)

7255 A/CONF.15/P/1339
BURN-UP CALCULATION OF NATURAL-URANIUM GRAPHITE-MODERATED POWER REACTOR BY USING DIGITAL COMPUTER. Mochinori Goto, Tasaburo Yamada, Tadasu Takegoshi, Megumi Fujinaka, and Toshio Morita (Electrotechnical Lab., Industrial Science and Technology Agency, Tokyo) and Toshio Yoshioka (Kansai Electric Power Co., Ltd., Osaka). 72p.

In the natural-uranium graphite-moderated power reactor, fuel shuffling and continuous charge-discharge on load are necessary in order to obtain a higher burn-up factor. It is desirable to predict the change in characteristics of the reactor during operation and the effect of fuel shuffling and continuous charge-discharge. The diffusion equation in which the coefficients vary with position was solved for cylindrical geometry by using the Relay-type Automatic Digital Computer in the Electrotechnical Laboratory. (W.D.M.)

7256 A/CONF.15/P/1364
THE SENN NUCLEAR POWER PLANT PROJECT OF ITALY. Carlo Matteini (Società Elettronucleare Nazionale, Rome). 18p.

Società Elettronucleare Nazionale, SENN, was assigned the responsibility by the Italian government for the selection, construction, and initial operation of a large nuclear power plant to be built in Southern Italy. The requirements and specifications for the plant, which will be located at the mouth of the Garigliano River on the Tyrrhenian seacoast between Rome and Naples, are discussed. The net electrical output of the plant will be between 130 and 150 Mw. Detailed invitations to bid on the construction were issued to many countries and the basis for the selection of the successful bidder is discussed. (J.S.R.)

7257 A/CONF.15/P/1380
CONSIDERATIONS ON THE USE OF THORIUM IN POWER REACTORS. D. Ciuffa and L. Sani (Comitato Nazionale per le Ricerche Nucleari, Milan). 47p.

After a review of the possibilities offered by thorium in nuclear power programs, a detailed study is made on the features of its use in thermal reactors, graphite-moderated and gas-cooled, as well as water-cooled and moderated. The design solutions considered include: one-region reactors with fuel elements formed by a mixture of thorium oxide and enriched uranium oxide; and multi-region reactors with enriched uranium oxide elements in the seed and thorium oxide elements in the blankets. The characteristics of both designs of reactors are examined with a view to obtaining an optimum for the power production or the fissile material production. Time-dependent trends of the reactivity and conversion factor are determined with relation to the progressive build-up of the fissile material. The elements which may frame-up a comparison between the two solutions examined are investigated in the light of the results obtained. Particular emphasis is placed upon the possibilities of steadily increasing, during operation, the reactor power production through the achievement of a better distribution of neutronic flux or through the utilization of power developed from fertile zones. (auth)

7258 A/CONF.15/P/1448
COMBINED USE OF NUCLEAR POWER AND PUMPED-STORAGE HYDRO STATIONS. J. M. Kay (Univ. of London) and A. A. Fulton (North of Scotland Hydro-Electric Board, Edinburgh). 20p.

An introductory review is given of the problem of meeting a varying demand on an electricity generating system. Typical daily load curves and annual load-duration curves are shown for different systems. Estimates are compared of the annual capital charges and running costs for different types of plant which will be operating in Western Europe in 1965-8. Particular reference is made to estimates for base-load nuclear stations, modern high-efficiency thermal plants, obsolescent thermal stations, and for conventional and pumped-storage hydro plants. Estimates for transmission costs are also given. A detailed comparison is made between nuclear and conventional thermal plants under conditions appropriate to Western Europe. Limiting load-factors, above which nuclear plants will be able to show a saving, are noted and estimates are given for the maximum economic nuclear capacity determined for the UK in this manner. (auth)

7259 A/CONF.15/P/1451
SPRAY EVAPORATION: A NEW METHOD OF STEAM GENERATION AND ITS POSSIBLE APPLICATION TO BOILING REACTORS. H. R. C. Pratt and J. D. Thornton (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 13p.

In an attempt to overcome the disadvantages of the normal type of boiling water reactor, a new method of steam generation has been devised in which the relative positions of the liquid and vapor phases are reversed, the liquid phase being dispersed in the steam, instead of vice versa. The coolant can thus be regarded as a suspension of liquid droplets carried in an inert carrier gas or in their own vapor. The potentialities of such two phase systems as reactor coolants are being investigated experimentally, with reference to the steam-water system. Preliminary heat transfer rates and pressure drop data have been determined experimentally at substantially atmospheric pressure in an electrically heated test section for various steam qualities, total flow rates, and heat fluxes. These experiments have shown that in the case of steam-water mixtures the heat transfer coefficients lie within the range 5,000 to 10,000 Btu/hr ft 2°F depending on the operating conditions employed. (auth)

7260 A/CONF.15/P/1518
INSPECTION AND MAINTENANCE OF LARGE REACTORS AT WINDSCALE WORKS AND CALDER HALL. T. Tuohy and G. D. Ireland (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). 44p.

An account is given of the maintenance and remedial work which has been done within the biological shield of the Windscale reactors, and covers: (a) Retention of reactor fuel elements which were tending to blow out of the graphite channels. (b) Remote welding and cutting operations using oxy-acetylene equipment at distances of up to 20 feet from the operating position. (c) Repair work on the fuel element detection gear which involved the entry of personnel into the biological shield. Details are given of the health physics control and of radiation exposures received by personnel during the maintenance of the fuel element detection gear. No maintenance work has been necessary within the biological shields on Calder Hall Reactors, but both heat exchangers and gas inlet ducts have been entered for inspection. The result of such inspections and health physics data are given. (auth)

7261 A/CONF.15/P/1522
OPERATING EXPERIENCE AT CALDER HALL. H. G. Davey, J. Gawthrop, and T. N. Marsham (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). 17p.

An account is given of the operating experience with the Calder Hall nuclear power plant. The operation of the control system and the degree of operational flexibility available are described together with the various engineering and nuclear limiting features. The performance and adequacy of important plant items such as the instrumentation and safety circuits, fuel elements, fuel handling equipment, and burst cartridge detection gear are discussed. Radiation levels experienced in operation and during maintenance work are referred to. It is concluded from the experience of 18 months operation that the Calder Hall reactors are satisfactory in service and possess a degree of reliability and flexibility which indicate that the gas cooled reactor system is well suited to the task of electrical power generation. (auth)

7262 A/CONF.15/P/1523
THE DEVELOPMENT OF THE HUNTERSTON FUEL ELEMENT. K. J. Wootton and W. E. Dennis (General Electric Co., Ltd., Erith, Kent, Eng.). 21p.

In order to extend temperature rating and service life obtainable from a fuel element consisting of natural U canned in Mg alloy beyond those being achieved in the Calder Hall Reactors, significant changes in the design were deemed to be necessary. The reasons for these changes are discussed and the metallurgical and heat transfer investigations which have made these developments possible are described. The evolution of the processes for reducing the permeability of the graphite support tubes is described. Experiments are described which were designed to determine the possible modes of failure of the various components and their effect of the reactor operation. (W.D.M.)

7263 A/CONF.15/P/1534
COMBUSTIBLES NUCLEARES PARA REACTORES DE GENERACION DE ENERGIA DE BAJA POTENCIA. (Nuclear Fuels for Low-Power Reactors.) G. E. Villar (Inst. de Technología y Química de la Facultad de Ingeniería y Agrimensura, Montevideo). 16p.

The development of low-power nuclear power plants for use in inaccessible areas with few sources of energy offers possibilities for the industrialization of many areas of the world. The use of power reactors in these remote regions necessitates a maximum irradiation period for the fuel elements. The factors which affect this period are discussed. The types of reactors which offer the best possibilities for use in the immediate future are described. Brief consideration is given to the control of enriched fuels. (J.S.R.)

7264 A/CONF.15/P/1641
NATURAL URANIUM REACTORS FOR SMALL AND MEDIUM POWER OUTPUTS. M. Dayal, S. R. Paranjpe, and M. R. Srinivasan (Atomic Energy Establishment, Trombay, India). 15p.

It is felt that graphite-moderated gas-cooled reactors using natural uranium start becoming unattractive for power outputs below about 60 Mw(e). Preliminary design studies were conducted on BeO-moderated gas-cooled and D_2O-moderated gas-cooled reactors. The considerations affecting the design of reactors of these sizes and the effect of local conditions are set out. Moderate pressure and temperature conditions were assumed. Results of calculations on BeO-moderated gas-cooled and D_2O-moderated gas-cooled reactors for different station sizes in the range of 10 to 50 Mw(e) are presented. Moderator and fuel inventories required are given. The problems, advantages, and disadvantages of these reactor types are discussed. The economic aspects of these reactors and of conventional stations of similar sizes are examined. These comparisons should be of interest for more detailed studies. (auth)

7265 A/CONF.15/P/1726
THE SIGNIFICANCE OF THE AIR CONDENSATION PROCESS "SYSTEM HELLER" IN CONNECTION WITH ATOMIC POWER STATIONS. L. Heller and L. Forgó (Budapest Technical Univ.). 10p.

The improved efficiency gained by using air-cooled condensers in steam power plants is discussed. Calculations are presented for a 100-Mw station in the German Federated Republic and the savings amount to 300,000 Dm/yr. (W.D.M.)

7266 A/CONF.15/P/1801
REACTEUR DE PUISSANCE DE 125 MW A EAU

BOUILLANTE ET A CYCLE INDIRECT. (A 125 MW Boiling Water Indirect Cycle Power Reactor). W. H. Zinn, J. M. West (General Nuclear Engineering Corp., Dunedin, Fla.), and G. C. Tavernier (Société Belge pour l'Industrie Nucléaire, Brussels). 29p.

A detailed description of a reactor which develops an effective power of 124.2 Mw is given. The reactor is of the boiling water type and uses slightly enriched, compressed and sintered uranium oxide as a fuel. The fuel assemblies are stainless steel clad. The relevant thermal and nuclear data pertaining to the reactor are presented and discussed. Pressure inside the reactor and throughout the primary circuit is 70 kg/cm^2 (1000 psi). This high pressure makes for excellent operational stability. The steam generated in the reactor is condensed in heat exchanger-condensers where it gives up its heat. The water which comes out of the core also passes through exchangers, in which it gives up some calories, so that it is cooled off as it returns to the reactor. Secondary steam is produced at 47 kg/cm^2 (660 psi) and is passed through a conventional-type superheater, leaving it at a high temperature (565°C or 1050°F), so that a very high thermodynamic efficiency can be achieved in the secondary circuit. The net efficiency of the power plant is in excess of 37%. Through careful optimization of all the technological elements which enter into the design of the power plant, it is possible to achieve a reasonable cost of the installed power and a kwh price which can be competitive in Belgium. (auth)

7267 A/CONF.15/P/1806

NUCLEAR POWER IN THE FEDERAL REPUBLIC OF GERMANY. Siegfried Balke (Bundesministerium für Atomkernenergie und Wasserwirtschaft). 10p.

The atomic energy program in Germany envisages the construction of several power reactors, with a total electrical capacity of approximately 500 Mw until 1965. The size of the individual project is to be about 100 Mwe. The following four reactor types are being developed by German industrial firms, partly in cooperation with foreign partners: a gas-cooled, graphite-moderated reactor of advanced design utilizing natural uranium; a reactor moderated and cooled by heavy water and utilizing natural uranium; a reactor moderated and cooled by ordinary water and utilizing slightly enriched uranium; and a gas-cooled high-temperature reactor of advanced design utilizing enriched uranium. The construction of plants for the manufacture of fuels and reactor materials has been included in the program. (auth)

7268 A/CONF.15/P/1940

CONDITIONS OF THE ECONOMIC OPERATION OF NUCLEAR POWER STATIONS IN POLAND. W. Frankowski and T. Wojcik (Inst. of Nuclear Research, Warsaw). 11p.

Approximate calculations indicate that in Poland in the years 1975-80 a shortage of coal should begin to make itself felt and that it will be necessary to bring into operation a series of nuclear power stations. In the transition period 1960-75, apart from plants of an experimental nature, the building of nuclear power stations will depend to a large degree on their ability to compete economically with other types of power sources. Using new data on the cost of power plant building and new methods of calculating the cost of production of a unit of energy, an attempt is made to define the position of nuclear power stations from the economic point of view in relation to thermal power stations based on coal, brown coal, water power, etc. (auth)

7269 A/CONF.15/P/1945

NUCLEAR STUDY OF A LOW POWER BERYLLIUM OXIDE NATURAL URANIUM POWER REACTOR. R. D. Jain and K. R. Srinivasan (Atomic Energy Establishment, Trombay, India). 12p.

Nuclear study for a small-sized BeO-moderated natural uranium, CO_2-cooled power reactor was made. The core parameters, including the bucklings with and without allowances for poisoning and temperature effects, were calculated for several sets of solid rod radii and the channel and cell sizes. Fixing the core size about 3 m high and 3.6 m in diameter, with 90 cm thick graphite reflector and the rod and channel radii at 1.35 cm and 4.0 cm respectively, so as to conform with 2.54 cm thick steel pressure vessel of diameter about 6 m and the heat transfer calculations, it is found that the thermal power output, which is about 33 Mw for the uniform core, can be increased by about 20% on breaking the core into two zones, while the fuel inventory is decreased by about 9%. The extra reactivity required for poison and temperature effects is found to be about 4%. (auth)

7270 A/CONF.15/P/2028

THE ECONOMICS OF FAST POWER REACTOR NUCLEAR FUEL. O. D. Kazachkovskii (Kazachkovsky), (U.S.S.R.) 20p.

The methods for calculating the fuel component in the cost structure of power produced by fast power reactors are defined. Account is taken of the many factors which determine the peculiarities of fast reactor operation. All considerations are made in relation to Pu–U^{238} closed cycles. (W.D.M.)

7271 A/CONF.15/P/2101

DESIGN OF AN EXPERIMENTAL 10 MW HOMOGENOUS REACTOR FUELED WITH CIRCULATING URANIUM OXIDE SUSPENSION IN LIGHT WATER. V. Zajíc, J. Pfann, and J. Gregor (Czechoslovak Academy of Sciences, Prague). 16p.

The designed homogeneous reactor with a fuel suspension of enriched U_3O_8 in the light water moderator is assumed to have a thermal power of 10 Mw and to generate in an external heat exchanger saturated water steam at 255°C and 44 atm. for a 2500 kw turboalternator unit. The highest operating temperature of the suspension is supposed to be 300°C, and a pressure reserve of 20 to 30 atm. is provided in order to avoid local boiling in the unequally heated suspension. Calculations show that a rather high thermal efficiency may be attained. (W.D.M.)

7272 A/CONF.15/P/2139

URANIUM-GRAPHITE REACTOR WITH SUPERHEATED HIGH PRESSURE STEAM. N. A. Dolezhal, A. K. Krasin, et al. (U.S.S.R.). 45p.

The basic physical and engineering characteristics are given of the thermal graphite–uranium reactor now under construction, with two groups of working channels. In the first group of channels, the heat generated is transmitted by the boiling water in the steam generator to the water of the second circuit. The secondary steam generated in the steam generator enters the second group of channels, where it is superheated at a pressure of 100 atm. to the required temperature and is supplied directly to the turbine. The reactor with the

100,000 Mw turbogenerator and other equipment forms a complete unit. The design of the reactor and the technological scheme of the reactor-turbine unit are described. Some considerations are given concerning the further possible development and improvement of power reactors of this type. The possibility of increasing the capacity of a single reactor and improving the economies of the discussed station is given. (auth)

7273 A/CONF.15/P/2140
ATOMIC ICEBREAKER "LENIN." A. P. Alexandrov, I. I. Afrikantov, et al. (U.S.S.R.). 45p.

A powerful nuclear-propelled icebreaker was launched lately in the USSR. Its nuclear plant guarantees autonomous navigation for a period of more than a year without refueling. The icebreaker displacement is 16,000 tons, and the capacity of the main turbines is 44,000 h.p. The icebreaker is capable of moving through two meter thick ice fields with two knots speed, and in ice-free waters with 18 knots speed. A description of the reactor and turbogenerating system is included. The whole plant consists of three pressurized water reactors. (auth)

7274 A/CONF.15/P/2144
COOLING OF WATER-WATER REACTORS. G. Kruzhilin and V. Subbotin (U.S.S.R.). 43p.

Comparatively small gaps between the fuel elements as well as the shape of the channels for the flow of water are the peculiarities of the heat exchange in the water-cooled and -moderated reactors. Nevertheless the results of the tests confirmed the possibility of employing the same calculation method as in the case of the fluid movement in a circular tube. Another peculiarity of water-cooled and -moderated reactors is the nonuniformity of heat production within the core. This is accounted for by the neutron diffusion, the deformation of the neutron field by the control rods, etc., and the variable nature of the influence exercised by these factors. As a result some difficulties are encountered in solving the problem of properly distributing the cooling water among individual fuel assemblies by means of throttling the water at the inlets. (auth)

7275 A/CONF.15/P/2145
BURNUP OF FUEL IN WATER-MODERATED WATER-COOLED POWER REACTORS AND URANIUM–WATER LATTICE EXPERIMENTS. S. M. Feinberg, E. S. Antsiferov, et al. (U.S.S.R.). 234p.

The method and the results are reported of numerical calculations of fuel burning in ordinary water-cooled and -moderated reactors with a homogeneous core which use fresh slightly enriched fuel. The point of departure of the method is the notion of stationary conditions at which the process is maintained in the reactor as a result of a regular replacement of the burned-out fuel by fresh fuel. The results of the calculations allow a conclusion to be drawn regarding the dependence of the fuel life and the isotopic composition of the discharged material on such factors as the percentage of enrichment of the fresh fuel, the water–uranium volume ratio, the dimensions of the core, and the frequency of fuel reloading. A study is made of the dependence of the fuel life and irregular heat production in the reactor on the trajectory of motion of the burning fuel in the core. The theory of a uranium–water reactor is proposed, which is formed by a periodic structure of greatly or slightly enriched zones. The results are given of experimentally studying the physical parameters of a uranium–water lattice. Slugs of natural and enriched uranium were investigated. The material parameter of the lattice was determined from measurements of neutron distribution. A new interpretation is discussed of the multiplication factor and of its components, suitable for a reactor with a hard spectrum of neutrons. Various parameters of the lattice are dealt with from this viewpoint. (auth)

7276 A/CONF.15/P/2183
EXPERIENCE IN OPERATING THE FIRST ATOMIC POWER STATION IN THE U.S.S.R. AND ITS WORK UNDER BOILING CONDITIONS. N. A. Dollezhal, A. I. Krasin, et al. (U.S.S.R.). 60p.

The operation of the first atomic power station in the USSR is described. Data are given on the performance of component parts of the reactor and power station. Results of investigations on the properties of the graphite moderator and the changes in properties during irradiation are given. The performance of cooling systems, heat exchangers, and tube-type fuel elements under non-stationary conditions is discussed. The advantages of boiling reactors over non-boiling reactors are also discussed. (W.L.H.)

7277 A/CONF.15/P/2184
WATER-WATER POWER REACTORS IN THE SOVIET UNION. S. A. Skvortsov (U.S.S.R.). 29p.

A pressurized-water reactor in which light water is used as a moderator and coolant has been selected for a number of atomic power stations of the Soviet Union. The paper briefly outlines the considerations underlying the selection of the parameters. The pressure and water temperature values in the reactor circuit are determined by the choice of the turbine circuit parameters. The neutron physical characteristics accounted for the design and arrangement of the core in which it is possible to obtain sufficiently intensive burn-up of the nuclear fuel. The specific power in the reactor core is determined by the limiting temperatures on the axis of the cylindrical fuel elements and the heat rate on the surface (not over 1.5×10^6 kcal/m^{2}hr), sufficiently remote from the value of critical heat rate. The final dimensions of the core and total thermal power (760 Mw) were fixed, proceeding from the over-all dimensions of the reactor steel vessel, which were to provide transportation of the vessel and its parts by rail. (auth)

7278 A/CONF.15/P/2186
SELF-REGULATION IN WATER-WATER POWER REACTOR. V. A. Sidorenko (Academy of Sciences, U.S.S.R.). 37p.

Various transient processes are investigated for the pressurized-water power reactor, caused both by variations of the external load and by variations in the working conditions of the circulating circuit equipment. With a rather high negative temperature coefficient of reactivity it is possible to count on reliable operation of the plant without special external power regulators. (auth)

7279 A/CONF.15/P/2196
FUEL ELEMENTS FOR WATER-WATER REACTORS OF ATOMIC POWER PLANTS. R. S. Ambartsumyan, A. M. Glukhov, et al. (U.S.S.R.). 37p.

Fuel rods with zirconium alloy tube cans have been developed for large-scale atomic power stations in the USSR. The sealing of the elements is made by argon arc and seam welding of the end faces. Rods made of sintered UO_2 are used as the core of the fuel elements. The fuel elements were subjected to prolonged tests in

the water loops of the reactor. The main tests were carried out at the fuel element surface temperature 300 to 310°C and at the thermal load up to 10^6 cal/m^2hr. Some tests were carried out with the surface temperature 350°C to obtain data on the margin of corrosion resistance of different zirconium alloy cans. The results of the tests have made it possible to choose the optimum fuel element design, the technology of production, and the method of disposition in the jacket. (auth)

7280 A/CONF.15/P/2296
A HOMOGENEOUS NATURAL-URANIUM [REACTOR WITH RECYCLING OF PLUTONIUM PRODUCED]. V. M. Byakov and B. L. Ioffe (U.S.S.R.). 25p.

A homogeneous natural-uranium heavy water power reactor using the plutonium produced in the reactor as an additional fuel is discussed. Most of the time the reactor operates under stationary conditions. In these conditions the reactor is continually loaded with a certain amount of natural uranium. Simultaneously, a mixture of the same amount is discharged from the reactor. Calculations are presented of the critical dimensions for a number of possible stationary regimes, corresponding to different concentrations of uranium in heavy water and to different fuel circulation times. Several possible ways of reaching a stationary level are considered. (auth)

7281 A/CONF.15/P/2327
EVALUATION OF FINNED TUBES FOR STEAM GENERATORS IN GAS COOLED POWER REACTOR SYSTEMS. F. Carr (Nuclear Power Co., Ltd., Knutsford, Eng.), C. Rounthwaite and P. A. Young (Head Wrightson and Co., Ltd., Thornaby, Eng.) 13p.

The power losses associated with the steam generators in a gas-cooled power reactor system are the gas side pumping and the finite temperature difference between the gas and water sides. A derivation is presented for reducing the power loss due to irreversible heat transfer to the basis applied to the pump power losses. An atmospheric air test rig of the closed circuit type and the associated experimental techniques are described. Experimental data are presented on heat transfer and pressure drop obtained from the extended surface tube used for the Bradwell power station. The correlation of the experimental results by some previously published methods is briefly discussed. (W.D.M.)

7282 A/CONF.15/P/2331
SAFETY CONSIDERATIONS FOR GAS COOLED THERMAL REACTORS OF THE CALDER HALL TYPE. F. R. Farmer and P. T. Fletcher (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.); and T. M. Fry (Atomic Energy Research Establishment, Harwell, Berks, Eng.). 10p.

The principles of reactor safety are considered, with particular reference to the Calder Hall type of gas-cooled thermal reactor. The need for codes of practice for engineering design in the atomic energy field is discussed, and the aims of such codes are defined. The limits of radiation exposure, both for occupational workers and the general public, are discussed. The principles of safety adopted in design to ensure that in normal operation the reactor is at all times operating within safe limits are considered, and the factors governing these limits are discussed. In assessing the safety of a reactor system, it is necessary to predict the cause and course of possible fault conditions and also to consider the possibilities of multiple failures. In particular, fault conditions occasioned by loss of coolant flow or by loss of coolant pressure are examined, and design considerations intended to minimize the effects of such failures are discussed. (auth)

7283 A/CONF.15/P/2342
THE SWEDISH NUCLEAR ENERGY PROGRAMME. Gustav Cederall (Atomkommittee, Stockholm). 8p.

An atomic energy policy for Sweden has been planned to counterbalance the dependence on imported oil and to check the relative growth in these imports. This energy policy has as its main component a program for building nuclear reactors for district heating and/or generation of electric power. The program is discussed. (C.H.)

7284 A/CONF.15/P/2419
GAS COOLED NATURAL URANIUM REACTORS FOR LARGE POWER STATIONS. THREE DESIGNS. Ragnar Liljeblad and D. Madsen (Allmänna Svenska Elektriska AB, Västerås, Sweden). 28p.

Two designs of heavy-water-moderated carbon-dioxide-cooled reactors and one graphite-moderated carbon-dioxide-cooled reactor are discussed. The designs are in a preliminary state and are to be regarded as feasibility studies. The three proposals that are described are: one reactor with 100-bar CO_2 as the coolant and of pressure tube design and one with 70-bar CO_2 and pressure vessel design, (both with heavy water moderator); and one reactor with 60-bar CO_2 as the coolant, graphite for the moderator, and a rock excavation for the pressure vessel. The plants are rated at 120 to 140 Mw(e), 180 Mw(e), and 275 Mw(e), respectively. (W.D.M.)

7285 A/CONF.15/P/2435
ATOMIC ENERGY IN THE NETHERLANDS. I. A PROGRAMME FOR THE USE OF ATOMIC ENERGY. (The Netherlands). 8p.

The power supply and demand situation is summarized for the period 1955 to 1975. It appears that in 1975 only one third of the need can be supplied by domestic coal and oil extraction. The feasibility of developing nuclear power is considered. (C.H.)

7286 A/CONF.15/P/2486
INTENSIFICATION OF HEAT TRANSFER IN A GAS-COOLED NUCLEAR REACTOR. F. Berger and V. Stach (Czechoslovakia). 17p.

The possibility of utilizing the partial ionization of the coolant gas in a reactor to increase the heat removal rate from fuel elements is investigated. Results from an experiment conducted in a gas-cooled loop are reported. It is concluded that in a gas-cooled reactor a considerable increase of heat transfer from the fuel element may be achieved by applying an electric field. The magnitude of the increase depends on the density of gas ionization, applied voltage, and the flow rate of the gas. (W.D.M.)

STABLE ISOTOPE SEPARATION

7287 A/CONF.15/P/102
PRODUCTION OF BORON-10 AND OTHER STABLE ISOTOPES. A. O. Edmunds and F. C. Loveless (20th Century Electronics Ltd., Croydon, Surrey, Eng.). 24p.

An approach to the design of isotope separation plants is outlined with particular reference to the isotopes of boron. A basic separation unit is described which consists of two packed fractionation columns of high separation efficiency. The units can be easily fabricated and economically operated to provide highly enriched iso-

topes at a moderate price. A unique control system is used to make the columns fully automatic. It is imperative in isotope separation systems that a rapid and reliable analysis of the product enrichment should be available, and the control instrumentation includes equipment for the continuous monitoring of the isotopic enrichment of the product by a neutron absorption technique. A number of high efficiency distillation column packings have been investigated and a new type of packing has been developed, particularly for use in distillation columns greater than 2 in. diameter. The packing is made from rectangular section metal wire woven into a mesh. It can be supplied in alternative materials chosen for their suitability to the fluids to be distilled. Operating characteristics such as pressure drop and height equivalent to a theoretical plate are given. Distillation columns for the production of the isotopes of boron are discussed including experience in operating a larger scale plant owned by U.K. Atomic Energy Authority. A comparison between this method and the chemical exchange system of an organic boron trifluoride complex is given based on operating data available. The economics of each system in relation to the scale of production and the product purity is given. (auth)

7288 A/CONF.15/P/257
EXACT DETERMINATION OF SMALL DIFFERENCES IN THE VOLATILITY OF ISOTOPES. Werner Kuhn, M. Thurkauf, and A. Narten (Univ. of Basel). 8p.

An exact determination of a small difference δ in the volatility of a mixture of isotopic molecular species is possible due to the fact that N_{eff}, the effective number of theoretical plates obtained, is under specific, simple, and well defined conditions equal to the reflux ratio R. The condition is that $R \times \delta \ll 1$ and $R \leq N_{\omega/4}$ where N_ω is the number of plates which would be observed for $R = \infty$. The validity of the relation $R = N_{eff}$ is experimentally verified in the cases of the separation of $C^{12}Cl_4$ from $C^{13}Cl_4$ and H_2O^{15} from H_2O^{16}. A packed column for determinations of δ according to this method is described. (W.D.M.)

7289 A/CONF.15/P/1124
THE SEPARATION OF XENON AND DEUTERIUM BY THERMAL DIFFUSION. D. Heymann (Foundation for Fundamental Research of Matter, Amsterdam). 25p.

A nuclear reactor of the suspension type is characterized by the fact that the fission products will continuously escape from the nuclear fuel and travel through the ensemble of fuel and moderator. Among these products, xenon isotopes are relatively important, and the separation of these isotopes from deuterium is one of the engineering problems connected with the maintenance of this reactor. Thermal diffusion separation in the gaseous phase offers a promising method for the extraction of xenon at very low concentrations without the addition of auxiliary components and with a minimum effort with respect to constructional considerations. The extraction can be performed even at higher pressures without the use of coolants, adsorbents, and pumps. Hence, it seemed worth while to investigate the properties of the mixtures. The thermal diffusion factor of xenon in deuterium has been determined at different temperatures, using the "two-bulb technique." At about 340°K it is of the order of +0.50. Xe^{133} was added in tracer quantities to the deuterium gas. Subsequently, an experimental thermal diffusion column of the hot wire type was designed and constructed, and the transport properties of this cascade were studied. It was found that the transport follows the theory quantitatively fairly well but is essentially smaller than the value expected by theory. A calculation of a column of the concentric cylinder type is tentatively given, using the results of the previous investigations. (auth)

7290 A/CONF.15/P/1266
CARACTERISTIQUES DES BARRIERES UTILISABLES POUR LA SEPARATION ISOTOPIQUE PAR DIFFUSION GAZEUSE. (Characteristics of Barriers Suitable for Isotopic Separation by Gaseous Diffusion.) Daniel Massignon ([Commissariat à l'Énergie Atomique, Paris]). 21p.

The characteristics of barriers suitable for isotopic separation by gaseous diffusion are described mathematically. It is shown how the results given by the experimental methods on structure control of barriers (A/Conf.15/P/1265) can lead to a representation of barriers and will permit the elimination of non-usable industrial barriers by detecting too numerous large pores or microfissures and the existence of leaks at the joints. The discussion is limited to the use of information given by the specific permeability and the separation efficiency. Some examples of routine measurements are given to show how imperfect barriers are detected. (J.S.R.)

7291 A/CONF.15/P/1267
ETUDE DU COEFFICIENT DE SEPARATION DE QUELQUES PROCESSUS CONCERNANT LES ISOTOPES DU LITHIUM. (Study of the Coefficient of Separation of Several Processes for Lithium Isotopes.) L. Perret, L. Rozand, and E. Saito (Commissariat à l'Énergie Atomique, Paris). 16p.

The coefficient of separation was determined for several processes for lithium isotope separation. Rayleigh distillation of lithium metal at a pressure of 10^{-1} to 10^{-2} mm in the temperature range from 565 to 680°C gave a separation factor between 1.032 and 1.036. Distillations at a higher vacuum 10^{-3} to 10^{-4} mm and in an argon atmosphere at a pressure of 3 mm were also investigated. The separation factors were lower. A study of the efficiency of a distillation column gave poor results in comparison with the values found for the Rayleigh distillations. Some studies were made of the electrolysis of molten lithium nitrate, the countercurrent of the salt at the cathode being obtained by the continuous addition of ammonium nitrate. An isotopic ratio of 13.14 was found in the anode compartment after 12 amp-hr, a lower value than that found by previous investigators. Experiments on the electrolysis of aqueous solutions were made with a mercury cathode. The solution was cooled by a current of water and the amalgam was recovered by a mercury current. After electrolysis, the residual lithium was analyzed chemically and isotopically. By use of Rayleigh's formula, a separation factor of 1.07 was found for lithium chloride and 1.04 for lithium hydroxide. The figures are larger than those published before. In the study of ion exchange, band displacement and a series of batch exchanges were investigated. A separation factor of 1.004 was found for the batch exchange. The band displacement gave a good total factor, although the unitary separation factors were low. The chemical exchange between LiBr in dimethylformamide solution and lithium amalgam gave a separation factor of 1.05 ± 0.025. The isotopic analyses were made by scintillation counting using the $Li^6(n,\alpha)$ reaction or mass spectrometry using lithium ions obtained by electron bombardment of LiI. (J.S.R.)

7292 A/CONF.15/P/1270
ETUDE D'UN ELEMENT DE CASCADE POUR LA SEPARATION DES ISOTOPES DU LITHIUM. (Study of a Cascade Element for the Separation of Isotopes of Lithium). Vallet, Kepes, Beaufils, and Belilowsky (Compagnie, Saint Gobain, France). 6p.

A method, based on the counter-current electromigration of isotopes in a molten medium, is given for the separation of lithium isotopes. The apparatus used consists of two sections, one for the anode and the other for the cathode, the two sections being connected by a horizontal porous diaphragm. The apparatus itself is pyrex or steatite NHF. The anode is of platinum, and the cathode is either aluminum or stainless steel. Molten lithium nitrate was used in the experiments, and fuming nitric acid was used as the regenerating agent. Some experimental results are given. (J.S.R.)

7293 A/CONF.15/P/1362
EXPERIMENTAL RESEARCHES ON THE RECTIFICATION OF LIQUID HYDROGEN TO OBTAIN DEUTERIUM. E. Kanda, S. Sato, et al. (Tohoku Univ., Sendai, Japan). 13p.

The liquefaction and rectification of hydrogen is one of the best methods for concentrating heavy hydrogen, because of the brief interval necessary to reach the stationary state of separation, the simplicity of the theoretical work, and the large yield of heavy hydrogen. However, the technology of refrigeration at such a low temperature was never established; and many difficulties must be encountered before there is industrial realization of this method. These difficulties were separately examined in the laboratory, and are now nearer solution. Hydrogen from natural water was concentrated to 100 and 200 times in concentration of heavy hydrogen through the rectification with a small column. In the second step, a miniature plant was constructed and the balance in material as well as heat was studied. (auth)

7294 A/CONF.15/P/1400
DIFFUSIONAL DISTILLATION IN A GAS STREAM. M. Silvestri, S. Villani, N. Adorni, and G. C. Angelino (Centro Informazioni Studi Esperienze, Milan). 20p.

A laboratory plant is described where fractional water distillation for O^{18} concentration is performed by diffusional distillation into a carrier inert gas. The operating pressure is not less than atmospheric, while the operating temperature (20 to 30°C) allows a good separation factor to be achieved. The whole plant is an assembly of 100 vertical pyrex glass tubes. A constant flow of air saturated by water vapor, running at high speed, forces a water film to rise along the inner surface of the tubing, where an efficiency of more than 80% for mass diffusion exchange is achieved. Water is separated from the gas and enters the following unit, while gas in countercurrent flows back to the preceding one. Air is pumped in a closed circuit by a gas compressor and is dried at its exit by a silicagel bed. Liquid water is fed to the plant, while a small water output is drained by condensation of the water vapor contained in a small fraction of the gas stream. Yearly output is about 8000 grs. of water, containing 0.4% H_2O^{18}, for 8000 operation hours. Possibilities of diffusional distillation into a gas stream are also discussed for isotopic concentration of different isotopes. (auth)

7295 A/CONF.15/P/1612
THE PRODUCTION AND DISTRIBUTION OF THE HEAVY ISOTOPES OF OXYGEN. I. Dostrovsky (Weizmann Inst. of Science, Rehovoth, Israel). 9p.

A description is given of a plant producing highly enriched isotopes of oxygen (over 90% O^{18} and about 2% O^{17}), at a rate of 12 grams a day of pure O^{18}. The experience in operating this plant over a period of several years is discussed. The uses of the enriched product of the plant and some details of its distribution are outlined. Some recent work on the further enrichment of O^{17} is also included. (auth)

7296 A/CONF.15/P/1807
ENRICHMENT OF THE URANIUM ISOTOPES BY THE GAS-CENTRIFUGE METHOD. W. E. Groth, K. Beyerle, E. Nann, and K. H. Welge (Univ. of Bonn). 17p.

The design, operation, and theory underlying the operation of gas centrifuges for the separation of uranium isotopes are described. (J.E.D.)

7297 A/CONF.15/P/2217
RAZDELENIE ISOTOPOV REDKOZEMEL'NYKH ELEMENTOV ELEKTROMAGNITNYM METODOM. (Electromagnetic Separation of Isotopes of the Rare-Earth Elements.) B. A. Alekseev, S. F. Bulygin, et al. (U.S.S.R.). 16p.

The isotopes of the rare earth elements are separated in electromagnetic facilities to furnish suitable isotopes for various physical investigations and to supplement the isotope pool. The work is carried out with a large four-chamber facility and a small-size high-dispersion separator. The small unit uses ionic sources discharging in the vapors of a ballast or working substance. The source and receivers employed in the large unit are of the conventional type. The separation process is described, and data concerning the operating conditions of the sources, the productivities attained, and the isotope composition of the enriched products are given. Owing to the high cost of the initial substances, they have to be regenerated. For the same reason it has been found advisable to substitute the individual rare earth elements by their more available and cheaper concentrates, particularly those obtained by fractional crystallization. The use of concentrates makes it possible to apply fine chemical refining to the isotopes after enrichment, when their quantities are much smaller than those of the initial substances. It is often possible simultaneously to isolate isotopes of accompanying elements as enriched preparations. For instance, certain isotopes of samarium have been isolated simultaneously with those of neodymium and gadolinium during the separation of the latter. The preparation of working substances for the separation of rare earth isotopes is described, as well as the procedures for chemical treatment of the enriched products. (auth)

7298 A/CONF.15/P/2303
AN ION SOURCE FOR STABLE ISOTOPE SEPARATION. P. M. Morozov, B. N. Makov, M. S. Ioffe, B. G. Brezhnev, and G. M. Fradkin (U.S.S.R.) 11p.

A universal ion source designed for stable isotope separation by electromagnetic means is described. A description is given of the investigations on the properties of a gas discharge occurring in UCl_4 vapors in a longitudinal magnetic field of the separation plant. The investigations show the dependence of the formation process of ions of different masses on the gas discharge parameters in the case of a complex molecule UCl_4. The practical results obtained with this source in the isotope separation of uranium and other elements are presented. For the uranium isotope separation the ion current (U^+) reached 0.3 a and the separation factor (for uranium) amounted to 25 to 30%.

Similar data on the separation of isotopes with intermediate masses are given. (auth)

7299 A/CONF.15/P/2304
INFLUENCE OF ELECTRIC FIELDS IN ION BEAMS ON ELECTROMAGNETIC SEPARATION OF STABLE ISOTOPES. M. V. Nezlin and P. M. Morozov (U.S.S.R.) 15p.

The results of an experimental study of the volume charge compensation of intense beams in electromagnetic isotope separation plants are presented. It is shown that in the ion beam of the separation plant there exist considerable electric fields responsible for the beam defocusing and for the decrease in the enrichment factor. Factors responsible for the creation in the ion beam of the high electric fields causing the sharp limitation of the ion beam current in the separation plant are established and methods for their elimination are found. The practical application of these methods of isotope separation permitted removal of the limitation and separation of different elements at maximum ion beam currents, e.g., 0.4 a; 0.45 a, and 0.7 a for the isotope separation of zinc, cadmium, and calcium isotopes, respectively. (auth)

7300 A/CONF.15/P/2305
RAZDELENIE IZOTOPOV NA ELEKTROMAGNITNYKH USTANOVKAKH V SOVETSKOM SOYUZE. (Separation of Isotopes by Electromagnetic Method in the U.S.S.R.) V. S. Zolotarev, E. G. Komar, and A. I. Il'in (U.S.S.R.). 23p.

A description is given of the electromagnetic separation plants used for the production of enriched isotopes in Russia. The characteristics of the electrical and vacuum equipment of the plants are given, and the design of an arc ion source is described. To separate isotopes of elements with low vapor pressures, high temperature ion sources with the crucibles heated either directly or by electron bombardment are used. Special ion sources which are used in the separation of alkaline elements or rare elements are described. (J.S.R.)

TECHNOLOGY

Feed Materials

7301 A/CONF.15/P/228
CANADIAN REFINING PRACTICE IN THE PRODUCTION OF URANIUM TRIOXIDE BY SOLVENT EXTRACTION WITH TRIBUTYL PHOSPHATE. J. C. Burger and J. McN. Jardine (Eldorado Mining and Refining Ltd., Port Hope, Ont.). 17p. (AECL-638). $0.25(AECL).

The recovery of high-purity uranium trioxide from uranium-bearing concentrates by solvent extraction with tributyl phosphate is described. Gravity and chemical concentrates, containing 10 to 80% U_3O_8, are blended and digested continuously with 55% nitric acid in cascade dissolvers to give a slurry containing about 300 g U/liter, 3N in free nitric acid. Uranium is extracted from the slurry in pulsed columns using 25 vol. % tributyl phosphate in an inert kerosene diluent. Extraction of thorium and other impurities is minimized by maintaining the uranium content at a high saturation density. Residual impurities and free nitric acid are removed from the solvent using a de-ionized water scrub. Uranium is re-extracted from the solvent with de-ionized water to give an aqueous solution containing 100 g U/liter. The stripped solvent is treated with aqueous sodium carbonate (7 wt. %) to remove residual uranium and any mono- or dibutyl phosphate, and it is then stored for reuse. The uranyl-nitrate solution (100 g U/liter) is concentrated in two thermo-syphon evaporators and is then denitrated batch-wise in stainless steel kettles to give uranium trioxide. This is carried by a vacuum system to storage hoppers, pulverized, and packed in drums for shipment. Sulfuric acid is added to the aqueous raffinate from the initial extraction to convert combined nitric acid into free nitric acid, which is recovered by distillation in a forced-circulation evaporator. The nitric oxide gases from digestion and denitration are converted to dilute nitric acid (30%) in an absorption tower. This dilute acid together with the acid recovered from the raffinate is concentrated to 55 to 60% nitric acid in a bubble-cap column. The bottoms from the raffinate evaporator are neutralized to a pH between 5 and 6 with hydrated-lime slurry to precipitate iron, arsenic, and other elements. The solid residue is separated on a rotating-drum filter and trucked to a disposal area. The filtrate, which satisfies the requirements of the International Joint Commission for waste disposal, is pumped into Lake Ontario. (auth)

7302 A/CONF.15/P/485
REDUCTION OF URANIUM FROM CARBONATE SOLUTIONS WITH HYDROGEN USING UO_2 AS CATALYST. Bela Bunji and Blagoje Zogović (Inst. for Tech. of Mineral Raw Materials, Belgrade). 11p.

UO_2 obtained from carbonate solutions by reduction with hydrogen and a nickel wire was used as catalyst for the reduction of uranium with hydrogen. The analysis of UO_2 used is presented. The reduction rate depends on the surface of the catalyst, but not on the concentration of uranium in the solution. The influence of the concentration of Na_2CO_3, $NaHCO_3$, and Na_2SO_4 at constant reduction conditions was examined. In the same reduction conditions, when the catalyst is absent, separation of UO_2 does not happen. By staying in the open air, UO_2 oxidizes partially, and this process is accompanied by a decomposition of the carbonate solutions. This can be avoided by preliminary activation of the catalyst, which does not change its catalytic properties. UO_2 separated by reduction of the solution was also used as catalyst for further reduction. The reduction effect is 99%. (auth)

7303 A/CONF.15/P/1001
SPECIAL PROBLEMS ARISING IN CONNECTION WITH THE PRODUCTION OF URANIUM METAL AND URANIUM COMPOUNDS. G. Wirths and L. Ziehl (Degussa Wolfgang near Hanau a.M., Ger.). 14p.

Apparatus and auxiliary equipment of a pilot plant for the manufacture of reactor-grade uranium metal from uranium concentrate are described. The purification of the uranium is done by a liquid-liquid extraction with tri-n-butyl phosphate, partly with centrifugal separators, partly with columns of special design. Exact data about the performance of these installations are given. Particular attention has been devoted to the precipitation of uranium from pure uranyl nitrate solution. Both the precipitation with hydrogen peroxide and with gaseous ammonia have been investigated to obtain the required purity with a high yield on one hand and precipitates on the other, which are, in regard to their grain shape, grain size, and grain size distribution particularly suitable for the technological processes following

precipitation. In contrast to the hitherto known methods, the precipitation of ammonium uranate is done by the introduction of a mixture of gaseous ammonia and air into the uranyl nitrate solution. It is shown that various precipitates can be obtained by alteration of the conditions prevailing during precipitation. Data are given on the purity of the uranium peroxide and ammonium uranate obtained. Processing of ammonium uranate to uranium tetrafluoride is done via calcination, reduction with hydrogen, and interaction with water-free hydrofluoric acid. For the two last stages a rotary kiln-type equipment is used. Reduction of uranium tetrafluoride to uranium metal is done by metallic calcium, the quality of which is thoroughly characterized. The container for the calciothermic reaction is described, and the results obtained are discussed. Finally, data are given on the change of nuclear purity over all stages of refining. (auth)

7304 A/CONF.15/P/1096
EXTRACTION OF URANIUM FROM ACID LEACH PULPS BY JIGGED-BED ION-EXCHANGE. T. V. Arden, J. B. Davis, et al. (Permutit Co. Ltd., London). 47p.

A technique of high efficiency for the extraction of uranium oxide without the necessity for countercurrent decantation or filtration of leach pulps is being developed. After leaching under normal conditions, the leach pulp is split by a small hydrocyclone into a slimes fraction of 20 to 30% solids content, and an underflow of sands containing 60 to 80% solids. The sands are washed by gravity flow through a cascade of cyclones operating with low-pressure drops and are discharged with negligible loss of soluble uranium. The slimes, at a pulp density between 20 and 30% depending on the characteristics of the ore, are pumped upwards through a column which contains a floating bed of a special coarse size anion-exchange resin held by the flow of pulp against a screen across the top of the column. Blockage of the bed and the screen is prevented by a slow gentle pulsation which is applied to the flow of pulp. Eluted resin is fed to the top of the column, and resin loaded with uranium is taken from the base of the bed, washed, and eluted in a separate system. Resin, stripped of uranium, is dewatered and recycled to the adsorption column. (auth)

7305 A/CONF.15/P/1251
THE MANUFACTURE OF PURE THORIUM NITRATE AT THE DU BOUCHET PLANT. C. Braun, Ch. Lorrain, R. Mahut, R. Mariette, J. Muller, and J. Prugnard (Commissariat à l'Énergie Atomique, Paris). 13p.

The uranothorianite ore which comes from the island of Madagascar is processed industrially at the du Bouchet plant in order to give a pure thorium salt, the nitrate, and a uranium concentrate, namely a uranate. The ore, after it has been treated by hand sorting, or enriched on the mine by a gravimetric method, appears as a dense rock (its specific gravity may reach 10) of a cubical structure. It consists essentially of a mixture of thorium and uranium oxide with concentrations of 50 to 75% of Th and 5 to 20% U. Usually whenever there is a high concentration of one of the elements in a given ore, the other one is found in a low concentration, and reciprocally, although this variation law is not absolute in its nature. Among the other constituents are Pb, Fe, Ce, Ra, and other radioactive elements, due to their repercussions on the processing method. Some aspects of the industrial achievement are discussed. (auth)

7306 A/CONF.15/P/1252
AMELIORATIONS APPORTEES AUX PROCEDES DE PURIFICATION DES COMPOSES D'URANIUM ET A LA FABRICATION DE L'URANIUM METAL A L'USINE DU BOUCHET. (Improvements in Uranium Concentrates Purification Processes and in Uranium Metal Fabrication, at the Bouchet Plant.) J. Decrop, M. Delange, et al. (France). 12p.

The development of techniques used at the Bouchet plant for uranium concentrate purification and metal fabrication is described. The principal changes were caused by the transition to industrial production, progressive abandonment of ore treatment as this task was performed near the mines, and the constant adaptation of techniques to different categories of concentrates. The topics discussed include dissolution, purification, preparation of UO_2, preparation of tetrafluoride, production of the metal, and improvements in microanalytic methods. (J.S.R.)

7307 A/CONF.15/P/1255
LA CHAUX COMME AGENT DE CONCENTRATION DE L'URANIUM. (Lime as a Concentrating Reagent for Uranium.) P. Mouret, J. Le Bris, R. Gautier, and M. Kremer (Commissariat à l'Energie Atomique, Paris). 18p.

A new method for the recovery of uranium from solutions from the sulfuric leaching of low-grade minerals is presented. It is based on the precipitation of uranium from the leach solution with lime or limestone. If the sulfuric acid content of the solution is not too high, a direct precipitation is used. At higher values of sulfuric acid, the precipitation occurs in two steps, a preliminary precipitation with limestone to remove the impurities and then a second precipitation with lime to recover the uranium. The industrial application of this chemical method for the concentration of uranium from leach solutions is discussed. The recovery of the uranium from the calcium preconcentrate was investigated, and the results of the tests are given. (J.S.R.)

7308 A/CONF.15/P/1414
OBTAINING URANIUM(IV) FLUORIDES BY ELECTROLYSIS WITH A MERCURY CATHODE. T. Batuecas Rodriguez, M. L. Aceña, F. de la Cruz, and Fernández Cellini (Junta de Energía Nuclear, Madrid). 45p.

The possibilities of reduction of the acid solutions of the uranyl ion with a mercury cathode are tested, along with a study of the most interesting variables of the electrochemical process. The optimal conditions for the separation of the uranium as a fluoride are determined, and a comparative study is presented of the products obtained by precipitation and joint reduction or a precipitation made after the reduction and separate from it, as well as of the factors which affect the yields and composition in each and every case. The degree of hydration is checked, in the products thus obtained, choosing experimental conditions applicable to the preparation of anhydrous fluoride. The method which has been developed applies to concentrated solutions used for the acid digestion of uranium minerals, and the respective yields, compositions, and purities in the products so separated are indicated. (auth)

Raw Materials

7309 A/CONF.15/P/129
A PRACTICAL PROCESS FOR THE SEPARATION OF MONAZITE AND ASSOCIATED MINERALS FROM LOW

GRADE ORES. Jin-Tai Shen, Heng-Yueh Li, and Tse-Hung Chao (Ministry of Economic Affairs, Taiwan, China). 7p.

A process is presented for the separation of monazite sands from magnetite, eliminite, zircon, and other heavy minerals by using electrostatic and magnetic separators alternatively. Wilfley tables were used for the complete removal of siliceous sand as a preliminary treatment. (W.L.H.)

7310 A/CONF.15/P/219
CANADIAN EXPERIENCE IN THE MEASUREMENT AND CONTROL OF RADIATION HAZARDS IN URANIUM MINES AND MILLS. S. D. Simpson, C. G. Stewart (Atomic Energy of Canada Ltd., Chalk River, Ont.); G. R. Yourt (Rio Tinto Management Services Ltd., Toronto); and H. Bloy (Eldorado Mining and Refining Ltd., Saskatchewan, Can.). 20p.

Apparatuses developed for field sampling and measurement of radon are described. A battery-operated air sampler for the collection of radon daughters is described along with a battery-operated, alpha scintillation detector for the measurement of radon daughter products. A method is presented for estimating rate of exposure to U from the excretion rate of U in urine, and evaluation of personnel exposed to U in mine and mill. The principles of airborne hazards control in Canadian mines are outlined and discussed in terms of ventilation, control of radon-laden water, and dust control. (W.L.H.)

7311 A/CONF.15/P/227
SOME VARIATIONS OF URANIUM-ORE TREATMENT PROCEDURES. E. A. Brown, A. J. Gilmore, et al. (Dept. of Mines and Technical Surveys, Ottawa). 14p. (AECL-637). $0.25(AECL).

Modifications of processing methods now used in uranium-ore treatment may permit reduced reagent consumption, simplified flowsheets, or products of lower impurity content. Exploratory work has been done on a number of such possibilities. In sulfuric acid leaching at controlled pH, recycling of the leach liquor in some cases may permit a worthwhile saving in acid consumption. Some ores may be suitable for semi-static leaching at relatively coarse grinds, permitting a simplified flowsheet using countercurrent thickeners for the combined purposes of leaching, separating liquids and solids, and washing the leach residue. In the recovery of uranium from sulfuric acid leach liquors, solutions of sulfate salts have been found effective for stripping uranium from amine solvent extracts. Products made from strip solutions of this type have shown improvements in impurity content over comparable ion-exchange products from the same original leach liquor. Solutions of carbonate-bicarbonate have been employed successfully in the laboratory for elution of anion exchange resin loaded with uranium from sulfuric acid leach liquors, and the problem of gassing in the resin bed previously encountered in this work was overcome. (auth)

7312 A/CONF.15/P/230
BENEFICIATION OF LOW-GRADE PEGMATITES. A. B. VanCleave and R. L. Eager (Univ. of Saskatchewan, Saskatoon, Can.). 20p. (AECL-640). $0.25 (AECL).

Possible methods of beneficiating Saskatchewan pegmatites for uranium recovery at competitive cost were investigated. The work has involved a study of several acid-leach techniques, a search for a suitable combination of flotation reagents, and the removal of uranium from sulfate-leach liquors by liquid-liquid extraction. The results of stagnant leach, rolling leach, acid cure leach, and percolation leach are tabulated. The techniques of acid-cure and percolation leaching are described. Suitable reagents were found for flotation of Charlebois Lake and Bleasdell Lake pegmatite. The results of pilot plant flotation tests are given. The leaching of flotation concentrates requires more sulfuric acid and more oxidizing reagent. Amberlite LA-1 can be used satisfactorily in the liquid-liquid extraction of uranium from sulfate leach liquors. (J.S.R.)

7313 A/CONF.15/P/1112
A PRELIMINARY ASSESSMENT OF THE IMPORTANT ECONOMIC FACTORS IN THE PRESSURE LEACHING OF LOW GRADE SOUTH AFRICAN URANIUM ORES. R. E. Robinson, G. S. James, et al. (Anglo American Corp. of South Africa, Ltd.). 23p.

A process is presented for pressure leaching low-grade South African U ores. The results of the plant operation are presented in some detail, particularly those which have an important economic aspect. With the results of this study it is possible to evaluate the economic advantages and disadvantages of the pressure leaching technique and to suggest a suitable plant design which promises to reduce significantly the cost of extracting U from the low-grade South African ores. (W.L.H.)

7314 A/CONF.15/P/1115
THE DEVELOPMENT OF A MINERAL BENEFICIATION PROCESS FOR THE CONCENTRATION AND RECOVERY OF MONAZITE FROM THE LODE DEPOSIT AT STEENKAMP'S KRAAL. E. T. Pinkney and V. C. Ward (Union of South Africa). 22p.

An account is given of the investigation which led to the establishment of a commercial process for the beneficiation of monazite together with a differential recovery of a copper-bearing concentrate from the unique lode occurrence at Steenkamp's Kraal in the Northern Cape Province. Present-day practice in the plant is described in detail. Initial examination of the ore and laboratory test work demonstrated that the mineral was finely disseminated and required relatively fine grinding for its release. This made the application of standard gravimetric procedures uneconomic because of high tailing losses. Recently, however, a technique utilizing heavy medium has been shown to be effective for bulk sorting of the ore prior to concentration of the monazite by flotation, the method that has been adopted for its recovery and beneficiation. (auth)

7315 A/CONF.15/P/1118
MINERALOGICAL STUDIES RELATED TO THE URANIUM RECOVERY AND EXTRACTION PROCESSES PRACTISED ON THE WITWATERSRAND WITH SPECIAL REFERENCE TO ACID LEACHING. W. R. Liebenberg and L. Taverner (Government Metallurgical Lab., Johannesburg). 41p.

The Witwatersrand gold–uranium ores consist of a compact metamorphosed quartz-pebble conglomerate, the uranium being situated in a fine-grained matrix composed of quartz and phyllosilicates. Uraninite and thucholite are the principal uraniferous minerals, and because of their occurrence in small grains and their brittle nature, direct physical concentration is not efficient. Gravity and electro-magnetic concentration procedures useful in connection with these ores are

described. Commercial uranium extraction is accomplished by leaching the ore with a solution composed of sulfuric acid and manganese dioxide in the presence of ferric sulfate. Recoveries of about 80% of the uranium contained in the ore are achieved. (J.R.D.)

7316 A/CONF.15/P/1248
POSSIBILITES OUVERTES EN MATIERE ECONOMIQUE PAR SELECTION RADIOMETRIQUE DES MINERAIS. (Economic Outlook for Radiometric Selection of Ores.) Philippe Formery and Valery Ziegler (France). 30p.

The radiometric grading of uranium ores is analyzed. The cut-off is defined, and its parameters are derived. Cut-off above ground and underground are statistically interpreted. An evaluation is made of the combined effects of both kinds of cut-off made in succession. The corrections to be made to the radiometric apparatus used are determined. Application of the theory of cut-off to the evaluation of reserves is discussed. (J.S.R.)

7317 A/CONF.15/P/1253
APPLICATION DE LA LIXIVIATION ALCALINE A L'EXTRACTION DE L'URANIUM DU SCHISTE DES VOSGES. (Alkaline Leaching—Its use in Uranium Recovery from Vosges Shales.) P. Mouret, P. Pottier, P. Soudan, and J. Le Bris (Commissariat à l'Énergie Atomique, Paris). 21p.

Although sulfuric leaching of uranium ores in the only method used in France at the present, some tests of alkaline leaching of these ores were successful. Vosges shales can only be treated economically with sodium carbonate solutions. The shales are described and the physical and chemical procedures for U extraction are discussed. A laboratory study of alkaline leaching and U recovery following this treatment was made. The results led to a pilot plant and semiindustrial study. It was concluded that the extraction of U from Vosges shales can be done on an industrial scale with a 65 to 80% yield. The sodium carbonate, which is only slightly corrosive, allows the use of ordinary steel, and the low consumption of the chemical (10 to 15 kg/ton of mineral) makes the extraction very economical. Uranium can be recovered by direct precipitation of sodium uranate. The ion-exchange recovery of uranium is economically feasible with alkaline leaching. (J.S.R.)

7318 A/CONF.15/P/1254
THE CHEMICAL TREATMENT OF URANIUM ORES IN FRANCE. P. Mouret and R. Sartorius (Commissariat à l'Énergie Atomique, Paris). 15p.

The chemical procedures used in France at the present time for the processing of uranium ores are described, and the possible modifications and improvements are indicated. Acid leaching is the only primary method used, but alkaline leaching was investigated. For uraniferous shales alkaline leaching is essential. A review is given of the processes utilized for the recovery of uranium from rich, medium-grade, and low-grade solutions. The possibility of using solvents or the precipitation of uranium with limestone was studied. The advantage of using uranyl nitrate solutions, rather than the uranate, for transportation to the refineries is discussed. (J.S.R.)

7319 A/CONF.15/P/1256
LIXIVIATION OXYDANTE DES PECHBLENDES ET PRECIPITATION DE L'URANIUM PAR L'HYDROGENE. APPLICATION AUX MINERAIS PAUVRES FRANCAIS. (Leaching under Oxygen Pressure with Carbonate Solution Reduction by Hydrogen.) Jean Claude Balaceanu, Fernand Coussemant, and Pierre Mouret (Inst. Francais du Pétrole, Paris and Commissariat à l'Energie Atomique, Paris). 47p.

A study was made of the basic characteristics of the leaching with carbonate solution under oxygen pressure and of the catalytic hydrogen reduction of low-grade French ores. Pure U_3O_8 was used in the investigations on leaching. The effects of oxygen pressure, temperature, initial surface of the oxide, surface during the course of the reaction, and concentration of the carbonate solution were determined. It was shown that the heterogeneous reactions involve a constant surface and two steps. A pilot plant experiment was made on a number of low-grade French ores. With ores the leaching is not sensitive to oxygen pressure. Dilute solutions of sodium uranyl carbonate are obtained from the leaching. The uranium can be precipitated as an oxide of a lower valent state by catalytic reduction with hydrogen. The study of this step was made on pure solutions of sodium uranyl carbonate in the presence of nickel and platinum catalysts. The reaction is strongly modified by the presence of even low concentrations of sodium bicarbonate. The reaction velocity increases with hydrogen pressure up to 5 atm, but then becomes independent of the pressure. The precipitation is accelerated by an increase in temperature. (J.S.R.)

7320 A/CONF.15/P/1257
LES PROBLEMES DE LA PRECONCENTRATION DES MINERAIS D'URANIUM PAR VOIE PHYSIQUE. LE TRIAGE ELECTRONIQUE. (The Problem of Preconcentration of Uranium Ores by Physical Processes.) Lucien Vuchot, André Ginocchio, et al. (France). 21p.

As uranium ores, like most other ores, are not definite substances which can be treated directly for the production of the metal, the ores must be concentrated. The common physical processes used for all ores, such as sieving, gravimetric separation, flotation, electromagnetic separation, and electrostatic separation, are applicable to the beneficiation of uranium. The radioactivity of uranium ores has led to a radiometric method for the concentration. This method is described in detail. As an example, the preconcentration of Forez ores is discussed. (J.S.R.)

7321 A/CONF.15/P/1361
ON A PROCESS FOR RECOVERING URANIUM FROM JAPANESE ORE. Shiro Yamagata (Mitsubishi Metal Mining Co., Ltd., Japan) and Yoshiki Imai (Atomic Fuel Corp., Tokyo). 23p.

Experimental work is described on a process for producing nuclear-pure UF_4 from Japanese ore. This process was developed with respect to a wet method of producing UF_4 which is likely to have less technical complexities than the dry method. It is based on a combination of solvent extraction and electrolytic reduction. (W.D.M.)

7322 A/CONF.15/P/1411
A LABORATORY INVESTIGATION OF THE ENRICHMENT OF THE URANIUM–COPPER MINERAL OF SANTA MARIA DE LA CABEZA. J. M. Josa, J. M. Guillén, P. Gasós, and L. G. Jodra (Junta de Energía Nuclear, Madrid). 47p.

A description is given of the tests made on the laboratory scale to enrich a uranium–copper mineral (0.087% U_3O_8 and 9.55% CuO). The study follows two general orientations: recovery and previous separation of the copper and leaching of the tailings from the pre-

vious treatment for the purpose of freeing the uranium; and leaching of the whole and recovery of the copper from the tailings by flotation, separation of the uranium by ion exchange, and precipitation of the copper from the liquids from which all the uranium has been extracted by cementation. The results of the concentration by flotation, acid leaching (sulfuric), and the sedimentation characteristics of the various pulps are given. (auth)

7323 A/CONF.15/P/1487
THE SEPARATION OF THORIUM AND THE RARE EARTH GROUP FROM MODERATE MONAZITE CONCENTRATES. PART I. O. Hilal, F. Saleh, and A. Kiwan (National Research Centre and Egyptian Atomic Energy Commission, Cairo). 17p.

Monazite was attacked by hot concentrated sulfuric acid. About 50% of the thorium and 95% of the lanthanides were separated from the monazite sulfate solution as double alkali sulfates and were converted into hydrous oxides by caustic soda solution. The thorium and cerium were separated quantitatively together with less than 2% of other lanthanides which went into solution on adding nitric acid to a suspension of the hydrous oxides, after being dried at 110°C, to pH 4. The thorium and ceric mixture was then dissolved in nitric acid, and after the reduction of cerium, thorium was precipitated completely by ammonia precipitation to pH 4.5 contaminated with not more than 4% of rare earths. About 98% of the thorium present in the filtrate of the double alkali sulfate precipitation was recovered together with heavy rare earths by salting the solution with sodium chloride. (auth)

7324 A/CONF.15/P/1528
RECENTLY DEVELOPED PROCESSES FOR THE EXTRACTION AND PURIFICATION OF THORIUM. A. Andsley and R. A. Wells (Chemical Research Lab., Teddington, Middlesex, Eng.), and W. D. Jamrack and A. E. Oldbury (United Kingdom Atomic Energy Authority, Preston, Lancs, Eng.). 36p.

Two processes of thorium extraction are based on the sulfuric acid breakdown of monazite, followed by selective precipitation of thorium oxalate or by adsorption on cellulose phosphate. A third process involves the pretreatment of rock monazite with dilute acid to render it more amenable to subsequent alkali breakdown. Two new source materials are available: Nigerian thorite ore, consisting mainly of thorium and zirconium silicates, and the barren liquors from several of the Canadian uranium extraction plants. New methods of ore breakdown and initial purification are described, excluding the final TBP extraction step. (W.D.M.)

7325 A/CONF.15/P/1554
APPLICACION DEL METODO DEL FOSFATO URANOSO A LA RECUPERACION DE URANIO DEL MINERAL ARGENTINO DE MALARGÜE, MENDOZA. (The Application of the Uranous Phosphate Method to the Recovery of Uranium from the Argentine Mineral of Malargue, Mendoza Province). M. F. Buhler, O. Fernández, J. R. Rodriguez, and G. Pozzi (Comisión Nacional de Energía Atómica, Buenos Aires). 11p.

The results of a study of the acid leaching of minerals of Cerro Huemul and the production of a high-purity uranium concentrate by the uranium phosphate method are reported. The various stages of the proposed process—acid extraction of the mineral, recovery of the copper by cementation, reduction of the uranium from its hexavalent to its tetravalent form, precipitation of the uranium as the phosphate, preparation of uranium dioxide from the phosphate, recovery of the dioxide from the unreacted phosphate, and precipitation of high assay uranium dioxide—are discussed. The process appears to be quite adaptable for the Cerro Huemul uranium mineral. A description is given of laboratory and pilot plant experiments. (J.S.R.)

7326 A/CONF.15/P/1595
SPECTROGRAPHIC DETERMINATION OF URANIUM IN ORES AND RESIDUES FROM LEACHING BY THE POWDER SIFTING METHOD IN THE A.C. ARC. J. Czakow, Z. Radwan, and B. Strzyżewska (Polish Academy of Sciences, Warsaw). 13p.

A method for determining uranium in residues after leaching of ores and in ores with high SiO_2 content is described. A sample of ore is mixed with powdered graphite in a 1:3 ratio and sifted through an electric arc. The range of the method is 10^{-1} to 10^{-3}% uranium, and the time of analysis is 5 hr for a single determination and 7 hr for 5. (W.D.M.)

7327 A/CONF.15/P/1670
PRODUCTION OF NUCLEAR GRADE THORIUM NITRATE. S. Fareeduddin, R. G. Garg, and H. N. Sethna (Atomic Energy Establishment, Trombay, India). 17p.

In order to modify the present process employed in India for the manufacture of mantle-grade thorium nitrate to produce nuclear-grade thorium compounds, experiments on a laboratory scale as well as on a semi-pilot scale were carried out. The present process is briefly described, and a flow sheet is included. The modification can be carried out from three different starting materials available in the present process: crude thorium hydroxide after removal of rare earths, thorium hydroxide obtained from thorium sulfate, and thorium chloride solution obtained after the dissolution of thorium hydroxide. (auth)

7328 A/CONF.15/P/1707
STUDIES IN THE RECOVERY OF URANIUM FROM A ZIRCONIFEROUS PEGMATITE IN RAJASTHAN. D. V. Bhatnagar, K. D. Kamat, and G. V. U. Rao (Atomic Energy Establishment, Trombay, India). 11p.

In certain localities in Rajasthan, uranium has been found in close association with a brown zirconium mineral (cyrtolite) in the pegmatites. The ratio of ZrO_2 to U_3O_8 varies from sample to sample. A picked sample has been found to contain as much as 7.5% U_3O_8 and 43% ZrO_2, giving a ZrO_2 to U_3O_8 ratio of 5:7. The presence of uraninite in the ore was confirmed by x-ray diffraction, microscopy, and autoradiography. The latter two methods indicate that uraninite is present in the cracks and crevices, in and around the cyrtolite grains. They further reveal that the contribution from the cyrtolite to the uranium content of the ore is much less than that from the uraninite in the fissures. The leaching tests also indicate that most of the uranium in this ore is present as the oxide mineral, uraninite, containing more of the lower oxide, UO_2, than the higher oxide, UO_3. At fine grind, most of the uranium gets leached out with dilute sulfuric acid in the presence of oxidizing agents, leaving the zirconium silicate grains, still containing some uranium, almost unaffected. The results of the studies in chemical extraction, especially the sulfuric acid leaching, and the recovery of uranium from the resultant pregnant leach liquor are presented. (auth)

7329 A/CONF.15/P/2061
SOME PROBLEMS OF RADIOMETRIC METHOD OF

URANIUM ORE CONCENTRATION. G. A. Kovda and M. L. Skrinichenko (U.S.S.R.). 16p.

The methods of determining the unevenness of uranium distribution in the pieces of ore and the means of utilizing the data obtained are discussed. Definite regularities in the radiometric method of concentration in connection with the questions of technology and equipment are deduced in mathematical form. General characteristics of the main design units of radiometric separators are given. Some examples of the flowsheets of the radiometric concentration are cited, and general data on technological characteristics attained in large-scale work are discussed. (auth)

7330 A/CONF.15/P/2064

KOMPLEKSNOE ISPOL'ZOVANIE URANOVYKH RUD. (Complex Utilization of Uranium Ores.) V. B. Shevchenko, S. I. Zolotukha, et al. (U.S.S.R.). 11p.

A method is described of complex processing of rich uranium ores which provides for the simultaneous extraction of uranium, radium, thorium-230, and protactinium-231 from the ore. The combination of nitrate leaching operation with uranium extraction by a tributyl phosphate solution in an inert diluent is a distinguishing feature of the uranium branch of the process. (auth)

7331 A/CONF.15/P/2154

INVESTIGATIONS ON ALKALINE METHODS FOR MONAZITE AND ZIRCON PROCESSING. G. E. Caplan and T. A. Uspenskaya (U.S.S.R.). 16p.

Along with sulfation in application to monazite, alkaline methods have been introduced recently on a commercial scale in a number of countries. Judging by the literature, the alkaline method of decomposition of the mineral is accomplished, as a rule, by heating finely ground monazite concentrates with solutions of caustic soda. The investigations discussed are devoted to a study of the preparation of thorium, rare earth, and phosphorus compounds from monazite by alkaline decomposition. The methods which were studied included fusion with caustic soda, treatment with caustic soda solution, sintering with soda ash, and sintering with lime. The raw material used was a concentrate containing about 95% monazite (about 50% to 60% total rare earth oxides, 7 to 8% thorium oxide, and 23 to 25% phosphorus pentoxide). A study of the conditions of sintering the monazite concentrate with soda ash showed that the addition of fluorine compounds, such as fluorspar or sodium silicofluoride, to the charge before sintering ensures a high degree of monazite decomposition at 800 to 825°C. (auth)

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